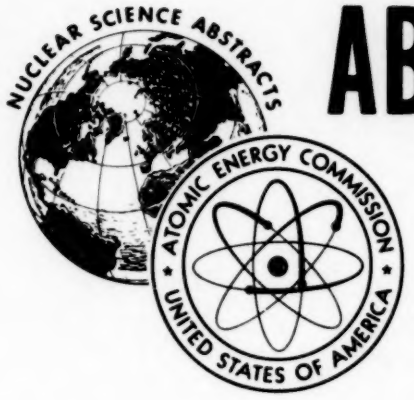
NUCLEAR SCIENCE ABSTRACTS



Volume 30 Number 10

Abstracts 26328-28910

November 30, 1974

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Volume 30, Number 10, November 30, 1974

NUCLEAR SCIENCE ABSTRACTS

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Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

SMITH, H., Planetary nebulae: two types, 29:13374
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Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstract 28682.

26328 (COM-74-10469) SURVEY OF VARIOUS APPROACHES TO THE CHEMICAL ANALYSIS OF ENVIRONMENTALLY IMPORTANT MATERIALS. Final Report. Greifer, B.; Taylor, J. K. (National Bureau of Standards, Washington, D. C. (USA)). Jul 1973. 238p. (NBSIR-73-209). NTIS $6.00.

Various approaches to the chemical analysis of heavy industry process materials and effluents for trace elements constituents that might contribute to environmental pollution are summarized. The capabilities and costs of nuclear methods, spark source mass spectrometry, x-ray fluorescence and electron microprobe spectrometry, atomic absorption spectrometry, absorption spectrophotometry, atomic emission spectroscopy, voltammetry (polarography) and potentiometry (ion-selective electrodes) for determining traces (less than 100 parts per million) of mercury, beryllium, cadmium, arsenic, vanadium, manganese, nickel, antimony, chromium, zinc, copper, lead, selenium, boron, fluorine, lithium, silver, tin, iron, strontium, sodium, potassium, calcium, silicon, magnesium, uranium, and thorium in such matrices as fly ash, coal, oil, ores, minerals, metals, alloys, organometallics, incinerator, particulates, slurry streams, and feeds to and from sedimentation processes have been assessed. The report includes a critically selected bibliography of the current literature. (auth)

26329 ELECTROANALYTICAL AND CATALYMETRIC MICRODETERMINATIONS OF MOLYBDATES. Jost, P.; Lagrange, P.; Wolff, M.; Schwing, J. P. (Institut de Chimie, Strasbourg). J. Less-Common Metals; 36: No. 1/2, 169-174(1974).

A comparative study devoted to the comparison of different methods for the microdetermination of molybdates was achieved in this laboratory: (a) polarographic reduction of Mo(VI) in citric acid medium, (b) polarographic detection of Mo(VI) in the presence of H_2O_2, (c) coulometric reduction of Mo(VI) by cathodic generation of Ti(III), (d) cathodic deposition and anodic reoxidation of MoO_2, (e) catalymetric determination of Mo(VI) acting as a catalyst in the homogeneous reduction of BrO_3^- by I^-. These methods are compared in relation to the minimum detectable concentrations or quantities of Mo(VI) and the error limits are indicated. Interference of tungstates in method (d) is studied. Method (e) also allows accurate determinations of tungstates, especially if tungstate is present as paratungstate B ion. Methods (a) and (c) have been used for the determination of the thermodynamic solubility product of $BaMoO_4$ and of the mean activity coefficients of this salt in sodium chloride solutions of increasing ionic strength (0 to 5 *M* in NaCl). (auth)

26330 POLAROGRAPHY OF MOLYBDATE IN THE PRESENCE OF ORGANIC SULFUR AND NITROGEN COMPOUNDS. II. The Polarographic Estimation of Molybdenum(VI) With Thioacetamide. Farr, J. P. G.; Laditan, G. O. A. (Univ., Birmingham, Eng.). J. Less-Common Metals; 36: No. 1/2, 161-168(1974).

The polarography of acidified solutions of molybdenum(VI) and thioacetamide is described. At pH 3.0 and concentrations of Mo(VI) above 1×10^{-5} *M* and of thioacetamide about 1×10^{-3} *M* chemical reduction by thioacetamide is very slow and a polarographic catalytic hydrogen wave is easily recorded. This can be used to determine molybdate and thioacetamide. More significantly, phosphate and silicate can be determined with a measure of amplification. (auth)

Activation and Nuclear Reaction Procedures

Refer also to abstract 28577.

26331 (F-598) COMPARISON BETWEEN TWO METHODS FOR DETERMINING IODINE IN URINE: NEUTRON ACTIVATION ANALYSIS AND AUTOMATIC COLORIMETRIC METHOD. Mathisen, O. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Jan 1974. 11p. (In Norwegian). Dep. NTIS (US Sales Only) $4.00.

A comparison has been made between two methods for measuring the concentrations of iodine in urine samples: neutron activation analysis (NAA) and a colorimetric method (ACM). The means (25.6 vs 25.2) and the standard deviations (1.7 vs 1.4) obtained by measuring on the same urine sample some 30 times by each method are not significantly different. A regression line $Y = 1.005 \times - 0.82$ (NAA/ACM), $r = 0.975$, $P \ll 0.001$, was found by correlating the results from parallel measurements of 38 different samples. (auth)

26332 NEUTRON-ACTIVATION DETERMINATION OF PHOSPHORUS AND ARSENIC IN HIGH-PURITY SILICA. Sukhanovskaya, A. I.; Yakovlev, Yu. V. Tr., Vses. Nauch.-Issled. Inst. Khim. Reaktivov Osobo; 34: 129-134(1972). (In Russian).

The procedure described includes the sequential substoichiometric removal of P and As from the irradiated sample by extraction, with 1,2-dichloroethane (I), of molybdo-phosphoric and -arsenic acids in the presence of tetraphenylarsonium chloride (II). The sample (1 g) and P and As standards are placed in a silica vessel and irradiated for 20 to 100 hr in a flux of $\approx 1.2 \times 10^{13}$ neutrons per sq. cm per sec., then set aside for 24 hr. The sample is then transferred to a PTFE beaker and heated with HF plus a few drops of HNO_3 in the presence of P and As carriers (0.2 mg of each). The treatment with HF is repeated until decomposition of the sample is complete, and the mixture is evaporated to dryness. The residue is dissolved by heating in 1 ml of 0.5 M-$HClO_4$, the soln. is transferred to a separating-funnel with washings of H_2O (1 ml), and the soln. is treated with 1 ml of 0.1 M-Na_2MoO_4 and diluted with H_2O to 5 ml. The P is extracted (to an extent of $\approx$ 60%) with 4mM-II in I (3 ml), the extract is separated and filtered and the β-activity of ^{32}P in 2 ml of filtrate is measured. From the remaining aq. phase the rest of the P is removed by extraction with butanol - $CHCl_3$ (1 : 4) (2 × 5 ml) and with I (2 ml), the organic phases being discarded. Then 0.8 ml of 4mM-II in I and 2.2 ml of I are added to the aq. soln., the extract is separated and filtered, and the activity of 2 ml of the filtrate is measured on a scintillation counter with a NaI(Tl) crystal. The radioactive purity of the separated elements is checked from the half-lives and the γ-ray spectra. The sensitivities of determination of P and As are 1 ng per g and 10 pg per g, respectively. (auth)

26333 OPTIMIZATION OF FIREARM RESIDUE DETECTION BY NEUTRON ACTIVATION ANALYSIS. Rudzitis, E.; Kopina, M.; Wahlgren, M. J. Forensic Sci.; 18: 93-100(Apr 1973).

From annual meeting of the Academy of Forensic Sciences; Las Vegas, NV (22 Feb 1973).

An investigation of the chemistry and radiochemistry involved in firearm discharge residue detection was carried out. The usefulness of internal standards was demonstrated. The details and pitfalls were pointed out for the benefit of the novice worker planning to acquire neutron activation analysis capability. (LK)

26334 NON-DESTRUCTIVE ANALYSIS OF ANCIENT BRONZE COINS BY ACTIVATION WITH 14-MeV NEUTRONS. Winkler, G. (Oesterreichische Akademie der Wissenschaften, Vienna). Int. J. Appl. Radiat. Isotop.; 25: No. 7, 328-329(Jul 1974).

Nondestructive analysis of coins by activation analysis yields results for the whole coin as compared with x-ray fluorescence analysis for which results only refer to a thin surface layer. A series of results using a 14-MeV neutron source for activation analysis for the determination of the copper and tin contents of ancient bronze coins using different experimental set-ups is given. The results agree to within 1%. The results were also compared to x-ray fluorescence studies from which it was shown that the ratio of tin to copper was larger by more than a factor of two for the surface in comparison to the results averaged over the whole volume of the analyzed objects as obtained by activation. Corrosion phenomena or an artificial treatment of the surface could be an explanation. (UK)

26335 HIGH ENERGY PHOTON ACTIVATION. Kosta, L.; Dermelj, M.; Slunecko, J. (Ljubljana Univ., Yogoslavia). Pure Appl. Chem.; 37: No. 1-2, 249-281(1974).

Interaction of high energy gamma photons with matter results in the formation of radionuclides, many of which have been made the basis for important applications in analysis. Of particular practical consequence is the possibility of sensitive and accurate determination of light elements, particularly beryllium, carbon, oxygen, nitrogen, and fluorine. Other important developments are nondestructive methods for a number of elements including strontium, zirconium, calcium, and iron in complex matrices such as silicates and biological materials. This survey includes general information on sources of photons, the character of their interactions with the sample, cross sections for the formation of radionuclides interesting in analysis, and data on sensitivities and possible interferences. Important data on recent applications are summarized in one of the Tables. In the Table of Isotopes condensed information is given on 236 isotopes of significance in analysis, including their reactions, threshold values, characteristics of the isotopes produced and sensitivities for a set of irradiation conditions. (auth)

26336 CHEMICAL SEPARATION AND DETERMINATION OF CHROMIUM, VANADIUM, AND MANGANESE IN STEEL BY 14 MeV-NEUTRON ACTIVATION ANALYSIS. Schmitt, B. F.; Segebade, C. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)). Z. Anal. Chem.; 270: No. 3, 193-198(Jul 1974). (In German).

6 figs.; 3 tabs.; 11 refs.

The elements are separated from iron by solvent extraction. Cr, V, and Mn are separated by ion-exchange chromatography with a strong acidic cation exchanger. The elements are determined by 14 MeV-neutron activation analysis using γ spectroscopy. The method is suitable for a concentration range of 0.05 to 5%. (auth)

26337 NEUTRON-ACTIVATION ANALYSIS OF ORES AND MINERALS. Gijbels, R. (Univ., Ghent). Miner. Sci. Eng., 5: No. 4, 304-348(Oct 1973).

The review deals with applications of neutron-activation analysis to geological samples: ores, minerals, and rocks. The various neutron sources suitable for this purpose are discussed. Applications using isotopic neutron sources are reviewed in detail, those using neutron generators are discussed on a more general basis. Present trends in instrumental neutron-activation analysis with reactor neutrons are briefly indicated, such as Ge(Li) gamma spectrometry, coincidence counting, delayed neutron counting, and nuclear track counting. (auth)

26338 SIMULTANEOUS DETERMINATION OF Na, K, AND Cu IN MINERALS BY NEUTRON ACTIVATION. Lobanov, E. M.; Khaidarov, A. (Physical-Technical Inst., Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR; 17: No. 4, 28-32(1974). (In Russian).

Tabulated data and gamma spectra of neutron-irradiated samples of minerals showed that the neutron-activation method is satisfactory for simultaneous determination of Na, K, and Cu under the proposed conditions. The minerals orthoclase and muscovite were studied. A multichannel analyzer was used in making the gamma spectra. (MG)

26339 SOME TRACE ELEMENT DATA AND THEIR INTERPRETATION FOR SEVERAL NEW REFERENCE SAMPLES OBTAINED BY NEUTRON ACTIVATION ANALYSIS. Randle, K. (Univ. of Birmingham, Eng.). Chem. Geol.; 13: No. 4, 237-256 (Aug 1974).

A number of problems associated with the geochemical application of instrumental neutron activation analysis are discussed. Particular emphasis is placed on the problems of preparing and using multi-element standard solutions and/or those associated with the accurate computer reduction of γ-spectral data. It is concluded that accurately and extensively analyzed rocks and minerals best fulfill the requirements for multi-element standards in this type of analysis. In the second part of the paper instrumental neutron activation analysis data are presented for 26 international reference samples including 4 of the less well-analyzed U. S. G. S. standard rocks. Some limited geochemical interpretations of the data are presented. (auth)

26340 DETERMINATION OF URANIUM AND THORIUM IN METEORITES BY THE DELAYED NEUTRON METHOD. Cumming, G. L. (Univ. of Alberta, Edmonton). Chem. Geol.; 13: No. 4, 257-267(Aug 1974).

Delayed neutron measurements of U and Th in three meteorites yield the following values:

	U(ppB)	Th(ppB)
Bruderheim	14.5 ± 1.0	171 ± 65
Peace River	11.8 ± 0.7	96 ± 46
Stannern	220 ± 6	563 ± 190

The measurements are made by comparison to gravimetric preparations of U and Th and the accuracy of the method has been checked by measurements on the U. S. G. S. standard grandiorite GSP-1 for which U and Th values of 2.570 ± 0.058 ppm and 106.6 ± 4.0 ppm were obtained (95% C.L.). The poor precision and accuracy for Th at low levels is caused in large part by interference arising from the oxygen in the samples and the uncertainty cannot easily be reduced in practice for meteoritic abundances. For most terrestrial rocks precisions of about 1–2% may be obtained for U with one irradiation and it is practical to obtain similar precision for Th with a reasonable number of repeat irradiations. (auth)

26341 PRECISE DETERMINATION OF URANIUM IN ROCKS AND MINERALS BY NEUTRON ACTIVATION ANALYSIS USING ^{133}I FISSION PRODUCT. Del Fiore, G.; Peters, J. M.; Roelandts, I. (Univ., Liege). Chem. Geol.; 13: No. 4, 309-319(Aug 1974).

A radiochemical neutron activation technique for uranium determination in rock and mineral samples is presented. The method is based on an alkaline fusion, a selective oxidation of iodine by a sodium-nitrite solution, followed by an iodine distillation technique for the isolation of the ^{133}I produced in fission. The outlined scheme is rapid, sensitive and reliable. Determination of uranium in U. S. Geological Survey standard rocks (G-1, W-1, G-2, BCR-1, AGV-1, GSP-1), C.R.P.G. Nancy geochemical standards (GA, GH, BR, Mica-Fe, Mica-Mg), C.A.A.S. reference syenite rocks (SY-1, SY-2, SY-3) and other analyzed rock samples are reported. These results are compared with those obtained by other methods. (auth)

26342 SORPTION PROPERTIES AND USAGE OF PHOSPHORUS-CONTAINING EXCHANGERS IN NEUTRON ACTIVATION ANALYSIS. Miklishanskii, A. Z.; Leikin, Yu. A.; Yakovlev, Yu. V.; Savel'ev, B. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 29: No. 7, 1284-1293(Jul 1974). (In Russian).

Sorption of U, Mo, W, Zr, V, rare earths, and some di- and trivalent elements from hydrochloric acid solutions by phosphorus-containing exchangers with amino, imino, thiourea groups was examined. Conclusions were made of the cation-exchange mechanism of the sorption of the elements by the polyampholytes studied from dependence of the element sorption on the ionic potential. Thermodynamic calculations of entropy and enthalpy factor changes indicated the ionic-coordination nature of the bond of phosphoryl groups of polyampholytes with uranyl ions and the ionic bond nature in the case of the rare-earth ions. The efficiency of analytical applications of the sorbents studied was shown on taking as examples neutron activation determinations of impurities of La, Yb, Ho, Sm, Dy, Eu, Gd in metallic uranium, impurities of Mn, Zn, Cu, Fe, Ga, Co in metallic molybdenum; impurities of Mo and W in metallic zirconium and impurities of Mn, Cu, Ga, Mo, W in ammonium vanadate. (auth)

26343 SELECTION OF AN OPTIMUM ANALYTIC PROCEDURE DURING INSTRUMENT ACTIVATION ANALYSIS. Petrenko, A. N.; Narkevich, B. Ya. Sov. At. Energy (Engl. Transl.); 35: No. 2, 743-744(Aug 1973).

Translated from At. Energ. (USSR); 35: No. 2, 121-125(Aug 1973). This is a summary of paper No. 678/6794.

The problem of the selection of an optimum analytic procedure during the instrumental activation analysis of multicomponent samples is considered. The heart of the problem is the determination of optimum time parameters (exposure time, delay after

exposure, and measurement time), and the energy at which the identification of the radioactive isotope of interest is conducted, as well as the flux density of the activating particles guaranteeing the required accuracy of the analysis. (LK)

26344 AN EXAMINATION OF CARBON DIFFUSION PROFILES IN STEEL SPECIMENS BY MEANS OF THE NUCLEAR MICROPROBE. Pierce, T. B.; McMillan, J. W.; Peck, P. F.; Jones, I. G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nucl. Instrum. Methods; 118: No. 1, 115-124(1 Jun 1974).

Carbon distributions through steel specimens 100 to 400 μm thick have been examined by nuclear microprobe techniques. The analytical determination was based upon the measurement of protons emitted by the $^{12}C(d,p)^{13}C$ reaction when samples were irradiated with 1.3 MeV deuterons. Beams of deuterons a few micrometers in diameter were used to irradiate small volumes of the sample, and spatial variations in carbon content were followed by moving the position of the deuteron beam and following the proton yield with beam location. The position of the ion beam on the sample was established by simultaneous measurement of emitted x-rays. Special steps were necessary to ensure that the overall carbon background of the accelerator was kept to within acceptable limits, and samples were calibrated by comparing emitted proton yield with that of standards. Repeat-scanning over the same region of the sample demonstrated good reproducibility. Microprobe results compared well with chemical determinations carried out by removing small quantities of the sample surface by micro-machining and subsequently measuring carbon in the removed material by combustion. The technique is illustrated by scans obtained during the examination of a number of stainless-steel samples. Experiments show that the method may be extended to the analysis of irradiated steel specimens. (auth)

26345 NITROGEN ISOTOPIC ANALYSIS USING LOW-ENERGY PROTONS. Malanify, J. J.; Close, D. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 118: No. 1, 293-297(1 Jun 1974).

The proton-capture reactions $^{14}N(p,\gamma)^{15}O$ and $^{15}N(p,\alpha_{1\gamma})^{12}C$ have been studied to determine their applicability to the analysis of materials for their ^{15}N enrichment. The system has been calibrated by measuring the gamma-ray yield from the $^{14}N(p,\gamma)^{15}O$ reaction and comparing it to the gamma-ray yield from the $^{15}N(p,\alpha_{1\gamma})^{12}C$ reaction as a function of known ^{15}N enrichment. Using this empirically determined calibration, other materials can be assayed. The technique is applicable to the analysis of samples with ^{15}N enrichments between 0.01 and 10.0%. (auth)

26346 ACTIVATION ANALYSIS WITH THE CYCLOTRON. KFK Nachr.; 6: No. 1, 9-13(1974). (In German).

6 figs.; 1 tab.

The calculation of detection limits for deuteron reactions of elements to be analyzed requires the knowledge of excitation functions of the reactions taken into consideration. These can be constructed in cases of reactions not yet studied experimentally from known excitation functions. The detection limits to be expected are here in the region below 10^{-9} g. Moreover, the neutrons produced secondarily in deuteron reactions in a beryllium converter may be utilized for activation analysis. In this case a broad spectrum of high neutron energies depending on the energy of the deuteron projectiles can be made available for the activation. A comparison with the detection limits that can be reached using 14-MeV generator neutrons demonstrates that considerably lower limits are obtained. In addition, by means of carefully chosen mean neutron energies the influence of disturbing side reactions can be excluded or at least be held low. (GE)

26347 SELECTIVE CHEMICAL SEPARATION PROCEDURES FOR ACTIVATION ANALYSIS. P. 1. The Separation of Mercury by Column Displacement Extraction. Erdtmann, G.; Aboulwafa, O. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Analytische Chemie). Z. Anal. Chem.; 270: No. 1, 1-6(Jun 1974). (In German).

3 figs.; 22 refs.

The application of the principle of displacement extraction in extraction chromatography leads to very selective column separation procedures. In the case of mercury separations for activation analysis the practical application of such a procedure is demonstrated. Mercury is quantitatively retained on columns containing a suitable support covered with a solution of copper dibenzyldithiocarbamate in chloroform acting as a quasi-solid extraction agent. Silver and occasionally some other precious metals will accompany the mercury but usually do not interfere with the determination. The preparation and the properties of the separation columns are described. (auth)

Chemical and Spectral Procedures

26348 (JUL-Bibl-18) GAS-CHROMATOGRAPHIC TRACE ANALYSIS OF He FROM GAS-COOLED REACTORS. A Bibliography. Cany, Y.; Hickert, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorbauelemente). Feb 1974. 37p. (In German). INIS.

The bibliography covers literature from October 1970 to August 1973 dealing with the gas-chromatographic analysis of mainly the following gases: H_2, He, O_2, N_2, Ne, Ar, Kr, Xe, H_2O, CO, CO_2, CH_4. (GE)

26349 (LA-tr-74-24) PULSE POLAROGRAPHY IN A NON-AQUEOUS MEDIUM: APPLICATION TO QUANTITATIVE ANALYSES OF ELEMENTS PRESENT IN THE STATE OF TRACES IN PLUTONIUM. Bergey, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). 1974. Translation of CEA-R-4478. 100p. Dep. NTIS $8.00.

Analytical methods for quantitative analysis of trace elements (Cu, Cd, Co, Ni, Mn, Zn, Fe, Bi, Tl, Pb, In, Sb, Be, Pd, Al, and U) present in a plutonium matrix were developed. The methods are based on the use of solvent extraction followed by a polarographic study of the extraction solvents. (LK)

26350 SIMULTANEOUS PHOTOMETRIC DETERMINATION OF MOLYBDENUM AND IRON IN TITANIUM ALLOYS. Engel, O. (SONP, Kladno, Czech.). Hutn. Listy; 28: No. 11, 816-818(1973). (In Czech).

Molybdenum and Fe were separated from the dissolved sample by extraction with isobutyl methyl ketone, the organic solvent was destroyed by combustion, and the Mo and Fe were converted into chloro-complexes and determined in 4M HCl, the extinctions at 270 nm and 340 nm (due primarily to Mo and Fe, respectively) being measured and simultaneous equations solved to take into account the contributions of both complexes to each extinction. Samples containing 0.06 to 0.6% of Fe and 0 to 3.5% of Mo were analyzed with good results. (Anal. Abstr.)

26351 DETERMINATION OF IMPURITIES IN HIGH-PURITY TELLURIUM. V. Spectrophotometric Determination of Traces of Lead and Bismuth With Dithizone by a Reversion-Bichromatic Method and by Using Standard Addition as Background. Kasterka, B.; Kwiatkowsak-Sienkiewicz, K. (Inst. Inorganic Chemistry and Technology, Danzig). Chem. Anal. (Warsaw); 18: No. 6, 1153-1161(1973). (In Polish).

The sample (3 g) was dissolved in HNO_3, and the solution was treated with CN^- and citrate and adjusted to pH 8.5 ± 0.3. The Pb and Bi were extracted into dithizone solution in CCl_4, re-extracted into 0.15M-HNO_3 and again extracted into dithizone solution, and the extinction (corresponding to Pb plus Bi) was measured at 620 nm. The Pb was reextracted from the CCl_4 phase into NH_4Cl solution, and the extinction of the dithizone solution was measured at 510 and 620 nm. The difference in the extinction at 620 nm gave the amount of Pb, and the content of Bi was found by a bichromatic-nomogram method from the extinctions at 510 and 620 nm. Lead (0.265 ± 0.095 ppM) and Bi (0.152 ± 0.082 ppM) were determined in "five-nines" tellurium (7 determinations of each, 99% confidence level). Detailed procedures are given. (Anal. Abstr.)

26352 SPECTROPHOTOMETRIC DETERMINATION OF URANIUM(VI) WITH 7-CHLORO-8-HYDROXYQUINOLINE-5-SULPHONIC ACID. Avinashi, B. K.; Banerji, S. K. (Birla Inst. of Technological Science, Pilani, India). Microchem. J.; 18: No. 5, 543-547(1973).

The orange-red U^{VI}-reagent (1:2) complex formed in aqueous solutions at pH 6.6 has a maximum absorption at 355 nm (at 30°); a sixfold excess of the reagent is the minimum required to form the complex. The analytical range is 5.7 to 28.5 ppM, the sensitivity is 0.036 μg per sq. cm and the mean error is <1%. Many cations interfere even at the 4-ppM level, but tartrate, I^-, Cl^-, Br^-, NO_3^-, and Ba can be tolerated in concentrations from 200 to 280 ppM. (Anal. Abstr.)

26353 COMPLEXOMETRIC AND SPECTROPHOTOMETRIC DETERMINATION OF THORIUM(IV), CERIUM(III), AND URANIUM(VI) WITH THE USE OF QUINIZARINSULPHONIC ACID AFTER SEPARATION BY ION-EXCHANGE RESINS. Issa, I. M.; Issa, R. M.; Ahmed, Y. Z. (Assiut Univ., Egypt). Microchem. J.; 18: No. 5, 569-576(1973).

The separation of Th, Ce, and U (as solutions of their acetates or sulfates in HCl or H_2SO_4) in a binary or tertiary mixture thereof is effected on a short column of anion-exchange resin (acetate form). Elution is carried out first with M-acetic acid (2 ml per min.), which removes Ce^{III} and Th^{4+}, the UO_2^{2+} retained on the column then being eluted with M-acetic acid-8M-HNO_3

(0.5 ml per min.). The Th and Ce can be separated by elution from a similar column with M-acetic acid–8M-HNO_3, Th being retained on the column; Th can then be eluted with M-acetic acid. Each metal can be determined either spectrophotometrically (between 550 and 590 nm) as a complex with quinizarinsulphonic acid (I) or titrimetrically with EDTA, I being used as internal indicator. In both instances, the pH must be adjusted to 5 (for Th) and 7 (for Ce) with $Na_2B_4O_7-H_3BO_3$ buffer solution. The titrimetric results for U are subject to a max. error of ≈–20%. (Anal. Abstr.)

26354 DETERMINATION OF Mo BY AN IMPROVED THIOCYANATE METHOD. Yatirajam, V.; Ram, J. (Kurukshetra Univ., India). Mikrochim. Acta; No. 4, 671-678(Jul 1974).

A 2 N HCl sample solution containing Mo up to 0.5 mg is boiled with hydrazine sulfate. Mo(V)-SCN complex is extracted with 1–2% TBA in chloroform from 2–3.5 N HCl and 0.8–1.8 M KSCN concentration. The accompanying ions are back-washed with 1% stannous chloride solution and the color is measured at 465 nm. Beer's law is obeyed from 0–20 μg Mo/ml solvent phase. Ti, V, Cr, Mn, Fe, Co, Ni, Nb, W, Re, Ru, Bi, U, and Ce do not interfere in much greater amounts than in the other thiocyanate methods for molybdenum. (auth)

26355 1-ALLYL-2-TETRAZOLINE-5-THIONE AS A REAGENT IN INORGANIC QUALITATIVE ANALYSIS. Micro-Detection of Iodate, Iodide, and Bismuth(III). Johar, G. S.; Dwivedi, R. C.; Majumdar, G. (Vikramjit Singh Sanatana Dharma Coll., Kanpur, India). Mikrochim. Acta; No. 4, 633-639(Jul 1974).

The sodium salt of 1-allyl-2-tetrazoline-5-thione (NaATT-5) is proposed as a new reagent for the detection of IO_3^-, I^-, and B(III) ions. An aqueous solution of NaATT-5 reduces IO_3^- in acid medium to free iodine (formed via iodide) which is detected by reaction with starch. $S_2O_3^{2-}$ is the only interfering species. I^- and NO_2^- interfere only when both are present together. NaATT-5 also reacts with bismuth to form a canary yellow precipitate of $[BiL_2]^+X^-$ (where X = a univalent anion other than I^-; L = ATT-5). When the yellow precipitate is treated with iodide, X^- is replaced by I^- to form a complex $[BiL_2]^+I^-$, which is orange in color. This reaction provides the basis for the detection of bismuth as well as of I^-. In the test for bismuth, Cu(II), Fe(III), $S_2O_3^{2-}$, IO_3^-, IO_4^-, and large quantities of NO_2^- interfere. The last four anions also interfere in the test for iodide. A method for the preparation of NaATT-5 is also reported. (auth)

26356 COMPLEXES OF SOME RARE EARTH ELEMENTS WITH 2-(4-SULFOPHENYLAZO)-1,8-DIHYDROXYNAPHTHALENE-3,6-DISULFONIC ACID IN SOLUTION. III. Spectrophotometric Determination of Rare Earths. Zelin'ski, S.; Radetska, V. (Poznan Univ., Poland). Zh. Anal. Khim.; 29: No. 6, 1224-1226(Jun 1974). (In Russian).

A spectrophotometric method was developed for determination of some rare earth elements with 2-(4-sulfophenylazo)-1,8-dihydroxynaphthalene-3,6-disulfonic acid. The determination selectivity is attained by arranging certain pH values. (auth)

26357 STUDY OF PROCESSES IN THE DIRECT CURRENT ARC DURING SPECTROGRAPHIC DETERMINATION OF Nb AND Ta. Semenenko, K. A.; Tarasevich, N. I.; Vigant, G. T.; Gul'ko, N. I. (Moscow State Univ.). Zh. Anal. Khim.; 29: No. 6, 1113-1117(Jun 1974). (In Russian).

X-ray analysis was applied to study end products of thermochemical conversions of niobium and tantalum pentoxides in a mixture with carbon powder and carbides of these metals in graphite electrode using the direct current arc. Carbides are the end products; lower oxides of niobium have been observed as well. The effect of the chemical form of the niobium and tantalum compounds was studied on the kinetic parameters and intensity of the spectral lines. The elements can be determined in carbon powder from unified calibration curves independing on the compound form (pentoxide, carbide, metal). A probable scheme of the transformation of Nb and Ta into the arc discharge was arranged. (auth)

26358 SIMPLE SELF-CONTAINED DELIVERY-ABSORPTION CELL SYSTEM FOR MICROPHOTOMETRIC TITRATIONS. Berger, S. A.; DeForest, P. R. (City Univ., New York). Mikrochim. Acta; No. 4, 689-696(Jul 1974).

A delivery-absorption cell system is described for photometric titrations using the Bausch & Lomb Spectronic 20. The cell system is simply constructed from readily available components and requires no modification of the spectrometer. The titration of zinc and thorium in the 0.25-μmol region gives accurate and precise results, requiring a total sample volume of only 5 ml. The system is entirely self-contained and the contents can be stirred by using a vortex mixer or by simply inverting the assembly. (auth)

26359 SPECTROPHOTOMETRIC DETERMINATION OF Ru USING 4,5-DIAMINO-6-HYDROXYPYRIMIDINE SULFATE. Veer, C. G. R.; Rhodes, T.; McDonald, C. W. (Southern Univ., Baton Rouge, LA). Mikrochim. Acta; No. 4, 611-616(Jul 1974).

A spectrophotometric method was developed for the determination of ruthenium based on the magenta colored complex (absorption maximum, 530 nm) formed when ruthenium and 4,5-diamino-6-hydroxypyrimidine sulfate are heated together in a slightly acidic solution. The molar absorptivity of the magenta colored complex solution is 6.5×10^3 liter $mole^{-1}$ cm^{-1}. (auth)

26360 DETERMINATION OF TRACES OF COPPER AND SILVER IN TANTALUM METAL BY ANODIC STRIPPING VOLTAMMETRY. Mizuike, A.; Miwa, T.; Fujii, Y. (Nagoya Univ., Japan). Mikrochim. Acta; No. 4, 595-601(Jul 1974).

Nanogram quantities of copper and silver are electrodeposited on a glassy carbon electrode from a hydrofluoric-nitric acid solution containing 0.5 to 1 g of tantalum. The deposit is then anodically removed in 0.1 M hydrochloric acid, a current-voltage curve being recorded. The impurities at the parts per billion level in high-purity tantalum metal powder are determined within 3 hours. (auth)

26361 REACTIONS OF SALICYLATE WITH URANIUM(VI) AND COBALT(II)-ALLYLAMINE COMPLEX. Micro Detection of Uranium(VI) and Salicylate. Johar, G. S. (Vikramajit Singh Sanatana Dharma Coll., Kanpur, India). Mikrochim. Acta; No. 4, 743-750(Jul 1974).

An aqueous solution of Na-salicylate (I) gives an orange-red color with U(VI) at pH ~ 7. Both U(VI) and salicylate can be detected by this test (the limits of detection are 45 μg and 25 μg respectively in 0.05 ml). A red-orange precipitate is formed when I is treated with U(VI) in presence of α,α'-dipyridyl at pH ~ 7. Thus, 200 μg U(VI) (in 0.5 ml) and 6 μg salicylate (in 0.05 ml) can be detected. In the test for U, Fe(III), Ru(III), Cr(III), Ce(IV), Cu(II), $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$, F^-, $C_2O_4^{2-}$, citrate, and tartrate interfere. The latter three anions also interfere in the tests for salicylate. Formate, acetate, succinate, benzoate, and acetylsalicylate do not interfere. Allylamine (II) gives a deep green precipitate with Co(II); however, if salicylate is added to Co(II) and the mixture is treated with II, a bluish-violet precipitate is produced. This forms the basis of salicylate detection (1 mg/0.25 ml). Oxalate, citrate, tartrate, and sulfosalicylate interfere. The nature of products formed in these tests has been discussed. (auth)

26362 PROPERTIES OF ALL-UNION STANDARDS FOR LEAD AND STRONTIUM. Dontsova, E. I.; Zykov, S. I.; Grinenko, V. A.; Artemov, Yu. M. (Commission on Isotope Standards for Geochemical Studies, Moscow). Geokhimiya; No. 6, 956-959(Jun 1974). (In Russian).

The results of analyses of lead and strontium standards showed the need for improving measurements of absolute isotope contents to obtain higher precisions. The reliability of the results would be increased by the use of mass spectrometry. Artificial mixtures of single isotopes should be made for calibration purposes. (tr-auth)

26363 EXTRACTION-PHOTOMETRIC DETERMINATION OF Ta BY MEANS OF OXAZINE DYE CAPRI BLUE. Elinson, S. V.; Nevzorov, A. N.; Belogortseva, M. V.; Mirzoyan, N. A.; Mordvinova, S. N. Zh. Anal. Khim.; 29: No. 6, 1234-1236(Jun 1974).

Complex formation has been examined between fluorotantalate and Capri Blue. The reagent forms an ion associate with fluorotantalate in solution 0.22 N in HF and 0.15 N in H_2SO_4 (pH 1) in the presence of tartrate ions. The associate is extracted into chloroform to the extent of 74%, its absorption maximum being at 660 nm. The reaction is highly sensitive, $\epsilon \approx 1.07 \cdot 10^5$. An extraction-photometric procedure has been worked out to determine 0.01 to 1% Ta in niobium, niobium pentoxide and other metals and alloys with a coefficient of variation 6–2% rel. (auth)

26364 OPTIMAL CONDITIONS FOR X-RAY SPECTRAL DETERMINATION OF TANTALUM BY USING AN INTERNAL STANDARD. Obol'yaninova, V. G.; Smagunova, A. N.; Pavlinskii, G. V.; Losev, N. F. (All Union Scientific-Research Inst. of Physico-Technical and Radio Engineering Measurements, Irkutsk, USSR). Zh. Anal. Khim.; 29: No. 6, 1160-1164(Jun 1974). (In Russian).

In x-ray spectral analysis using the internal standard method the element–standard has to be chosen in such a way that the spectral lines of the elements to be compared were absent between their absorption edges. If the tantalum content varies significantly, zinc is the best element to be used as the internal standard. If the tantalum content is small, copper can be used as the internal standard. In both cases about 5–10% of the element is introduced into the sample. The contents of La in the sample has to be 2

times less than the Ta contents to ensure particular accurate determinations. Tungsten is applied if Zn cannot be used as the internal standard. Small amounts of tungsten have to be introduced into the sample in this case. (auth)

26365 SEVENTEENTH INTERNATIONAL CONFERENCE ON SPECTROSCOPY, FLORENCE, ITALY, SEPTEMBER 16–22, 1973. Volume I. Milan; Associazione Italiana di Metallurgia (1973). 448p. (In Several Languages). (CONF-730914-(P1)).

The 198 papers presented at the conference are compiled in three volumes. In the first volume, containing 80 of the papers, separate abstracts were prepared for five papers. (JSR)

For abstracts of individual papers see: 26366–26370.

26366 STUDY OF PARAMETERS GOVERNING THE EMISSION OF RARE EARTHS IN THE ANALYTICAL ARC. Application to the Problem of Trace Determination. Antic, E.; Caro, P.; Schiffmacher, G. (CNRS, Bellevue, France). pp 191-196 of Seventeenth International Conference on Spectroscopy. Vol. I. Milan; Associazione Italiana di Metallurgia (1973). (In French).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-(P1).

Conditions were determined for excitation for lanthanum lines in the analytic electric arc. The excitation was studied with respect to the nature of the spectroscopic buffer (alkali chloride or alkaline earth chloride, alkali or alkaline earth sulfate, mineral oxides) of the current intensity of the gaseous atmosphere through the arc. The emission lines of LaI, LaII, and the LaO molecule were measured with respect to arcing time for each particular set of conditions; we have found a characteristic dependency of the intensity of LaII lines on the cation of the spectroscopic buffer (through the arc temperature) and also on the nature of the anion (through the electron pressure). Energy exchanges between the excited species LaII and the one for the LaO molecule are an explanation for the observed difference. When those results are applied to the problem of determining trace amounts of rare earths in another rare earth, it is found that it is necessary to use as an internal standard the rare earth matrix. Then differences between spectroscopic buffers and other parameters can be greatly reduced. Internal standards such as Pd, Fe, Ca are not to be used, because of the special behaviour of the rare earth elements. For the problem of determining traces of rare earths in any material, one must get the highest intensity for the emission of LnII (Ln-rare earths), and for this reason "cold" spectroscopic buffers, like KCl for instance have to be used together with a gaseous atmosphere enriched in oxygen (as CO_2). In these conditions the LnO molecule is easily produced and is stable, its dissociation temperature being around 6000°K and the emission of LnII is favorized, meanwhile the background remains low. Those results were applied to determination of rare earth oxide purity (specially La_2O_3), and determinations of rare earths in sedimentary rocks. The spectrographic method can be compared favorably with more expensive or more delicate methods such as neutron activation or mass spectrometry. (auth)

26367 HIGH-RESOLUTION OPTICAL NITROGEN-15 ANALYSIS. Middelboe, V. (Royal Veterinary and Agricultural Univ., Copenhagen). pp 241-245 of Seventeenth International Conference on Spectroscopy. Vol. I. Milan; Associazione Italiana di Metallurgia (1973).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-(P1).

Some new developments in the determination of ^{15}N frequency in N_2 samples by emission spectroscopy are briefly described. The determination of the ^{15}N concentration with commercial devices gives no absolute values. A high resolution optical method of ^{15}N analysis is described, which may suffice for the calibration of commercially available optical analyzers. The commercial instrument is calibrated by the use of an isotope mixture in a desired ^{15}N frequency region and a series of mass-spectrometrically prepared standards of different ^{15}N abundance. The commercial instrument must be used in conjunction with a special holder for attaching the discharge tube to the vacuum line. The application of this method to a single sample with low ^{15}N enrichment gave a relative error of 4%, whereas without the calibration and holder the error was 20%. This variation is significant since in biological tracer studies with ^{15}N the size of the experimental uncertainty is 10% before the analysis. (tr-auth)

26368 DETERMINATION OF RARE-EARTH ELEMENTS BY MASS SPECTROGRAPH. Strasheim, A.; Strelow, F. W. E.; Jackson, P. F. S. (Council for Scientific and Industrial Research, Pretoria). pp 306-309 of Seventeenth International Conference on Spectroscopy. Vol. I. Milan; Associazione Italiana di Metallurgia (1973).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-(P1).

A mass spectrographic method was developed to determine the rare earths in very low concentrations in silicate minerals. A brief description of the technique (a combination of ion exchange chromatography and spark mass spectrography) and the reasons for its selection are reported. Both the precision of the photographic registration and a comparison of the accuracies between international standards and the results obtained with this method satisfied the required limits of detection, precision, and accuracy. No isotopic differentiation was found. (JSR)

26369 SPECTROGRAPHIC DETERMINATION OF TRACE ELEMENTS IN FERROUS MATERIALS. De Gregorio, P.; Morello, B.; Savastano, G. (Centro Sperimentale Metallurgico, Rome). pp 366-370 of Seventeenth International Conference on Spectroscopy. Vol. I. Milan; Associazione Italiana di Metallurgia (1973). (In Italian).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-(P1).

A method is described for the spectrographic determination of trace elements in ferrous materials. The powdered sample is first mixed with polytetrafluoroethylene and graphite in the ratio 100:10:25. This mixture is then submitted to direct excitation in a 10 amp dc arc, utilizing a capped supporting electrode of the Scribner–Mullin type, with reverse polarity (sample: negative; counter electrode: positive) the spectrum being taken from the central-cathodic region of the arc. The method may be used to determine Al, As, B, Co, Cr, Cu, Mn, Mo, Nb, Ni, Pb, Sb, Sn, Ti, V, Zn, and Zr. The detection limits are indicated as are data on the precision and accuracy obtainable. (auth)

26370 KINETIC THERMOCHEMICAL REACTIONS OF TUNGSTEN AND URANIUM COMPOUNDS IN A GRAPHITE MATRIX IN THE DIRECT CURRENT ARC AND THEIR INFLUENCE ON THE SPECTRAL LINE INTENSITIES. Rautschke, R.; Amelung, G.; Dowe, C.; Nada, N. (Martin-Luther-Univ., Halle/Saale, Ger.). pp 395-397 of Seventeenth International Conference on Spectroscopy. Vol. I. Milan; Associazione Italiana di Metallurgia (1973). (In German).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-(P1).

Under the conditions of excitation in a dc arc not only the physical processes play a role in reviewing the spectral line intensities but also the thermochemical reactions occurring between the constituents in the electrode cavity. Information on the reaction kinetics can be gained, if it is possible to determine the dependence of the concentration variation on time. Under the conditions of the excitation by a dc arc this can be achieved by the interruption of the thermochemical reactions after various excitation times. The reaction products from the electrode cavity could be studied by quantitative x-ray phase analysis. The investigations were carried out on tungsten and uranium compounds in a graphite matrix. Tungsten and uranium compounds in a graphite matrix form the carbides WC, W_2C, UC, and UC_2 during the excitation in the dc arc. The results of the quantitative x-ray phase analysis could be compared with those of spectralanalytical determinations. The experiments succeeded in demonstrating the dependence of the spectral line intensities on those thermochemical reactions occurring in the period concerned. Only the intensity values gained by total evaporation allow the determination of the concentration of the elements. (auth)

26371 SEVENTEENTH INTERNATIONAL CONFERENCE ON SPECTROSCOPY, FLORENCE, ITALY, SEPTEMBER 16–22, 1973. Volume II. Milan; Associazione Italiana di Metallurgia (1973). 423p. (In Several Languages). (CONF-730914-(P2)).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973).

Of the 74 papers compiled in the second volume, separate abstracts were prepared for eight. (JSR)

For abstracts of individual papers see: 26372–26378 and 26405.

26372 USE OF THE DISCHARGE IN A HOLLOW CATHODE FOR THE DETERMINATION OF RARE-EARTH ELEMENTS IN AMERICIUM. Zakharov, E. A.; Nyasoedov, B. F.; Karyakin, A. V.; Ozhegov, P. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). pp 461-464 of Seventeenth International Conference on Spectroscopy. Vol. II. Milan; Associazione Italiana di Metallurgia (1973).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-P2.

Results of the determination of La, Eu, Sm, Nd, and Pr in the dry residues of pure solutions and in the presence of ^{241}Am using a hot hollow cathode are given. A cooled quartz-glass hollow

cathode with changeable electrodes and a prismatic grating spectrograph with a three-lens condenser system were used. The change of the intensity of the lines of the rare earth elements with variation of the He pressure and of the current was examined. The corresponding characteristics of the discharges are given: volt-torr and volt-amp. The similarity of the volt-amp characteristics of the discharges with Eu and ^{241}Am is noted. The possible mechanism of the input of the rare earth elements and of ^{241}Am into the discharge and the excitation procedure of the particles of the rare earth elements and of ^{241}Am is examined. The results of the thermodynamic estimations of the partial pressures of the rare earth elements above the Ln–O and Ln–C systems are given. In order to determine the effect of gaseous impurities in the He on the intensity of the lines of the rare earth elements, the coefficients of the correlation among the blackening of the rare earth lines, H_δ and the head of the N_2^+ band at 3914.4 Å were calculated. The detection limits of the rare earths and the relative standard deviations are given. (tr-auth)

26373 SPECTRAL DETERMINATION OF IMPURITIES IN TUNGSTEN AND ITS ALLOYS OF HIGH PURITY. Jaxa-Bykowski, W.; Masiak, R. pp 513-518 of Seventeenth International Conference on Spectroscopy. Vol. II. Milan; Associazione Italiana di Metallurgia (1973). (In German).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-P2.

A spectrochemical method of the contamination determination in tungsten and tungsten–rhenium alloys (4.5% Re) as well as in tungsten–thorium (2.5% Th) showing a high degree of purity was developed. The following elements were determined: Ag, Cu, Tl, Bi, Ni, Fe, Mg, Pb, Mn in the concentration 3.10^{-3} to 1.10^{-4}% and Cd, Zn, Cr, Sb, and As in concentrations of 1.10^{-3}% to 3.10^{-2}%. Samples of tungsten, tungsten–rhenium alloys and tungsten–thorium were oxidized. The oxides were mixed with graphite powder having a spectroscopic carrier and then they were arced in the dc arc out of the carbon electrode crater. The method allows the simultaneous determination allows of 16 elements in tungsten and in alloys of tungsten–rhenium and tungsten–thorium and its characteristic trait is relatively small error and good repeatability of the results. Variation of the coefficient V is contained in the limits ±6.9 to 15% in the particular element determinated. For the analysis of tungsten alloys (W–Th and W–Re) for the content of the determinated contaminations, there were applied various physical–chemical methods. Experimented examinations prove that the applied method is free of the systematic error and that the accidental errors in some of the methods oscillates in the limits of 10 to 40%. (auth)

26374 SPECTROGRAPHIC DETERMINATION OF NITROGEN IN STEEL BY THE ISOTOPIC DILUTION METHOD. Galazka, J. (Inst. for Nuclear Research, Swierk, Poland). pp 665-671 of Seventeenth International Conference on Spectroscopy. Vol. II. Milan; Associazione Italiana di Metallurgia (1973). (In French).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-P2.

In the Institute of Nuclear Research at Swierk has been constructed an apparatus for the determination of gases in metals by the isotope dilution method. This work was aimed at examination of the suitability of the method for the control of some important samples. A method of the determination of nitrogen was elaborated in detail. The method is based on measurement of the N_2 band at approximately 3162 mm. Good agreement with standard reference samples was obtained. However in some materials containing high melting phases incomplete isotope exchange was observed and too low results were obtained. This difficulty was circumvented by addition of fluxes. (auth)

26375 SPECTROCHEMISTRY OF EMISSION AT THE SERVICE OF ARCHAEOLOGY. Alvarez Herrero, C.; Burriel Marti, F. (CSIC, Madrid). pp 677-681 of Seventeenth International Conference on Spectroscopy. Vol. II. Milan; Associazione Italiana di Metallurgia (1973).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-P2.

The emission spectrochemical technique was applied to the analysis of both the surface and the interior of ceramic samples furnished by the Archeological Museum of Madrid. The elements found were Si, Ca, Mg, Al, Fe, Na, K, Cr, Ti, V, Ni, Pb, Mn, Sr, Zr, Sn, W, Mo, Co, Zn, and Bi. For the quantitative determination three series of spectral patterns were prepared. Each series contains a different set of elements with a different oxide used as internal patterns. In all cases four spectral patterns are used with the concentration of each element in them decreasing in the order 10^4, 10^3, 10^2, and 10 ppm. A series of chemical characteristics for each of the types of ceramics studied were deduced. They allow a differentiation of the ceramics and lead to a selective identification of ceramics of doubtful origin. The ceramics studied were classified as aticas (4th century B.C.), campanienses (2nd and 3rd century B.C.), sigillatas of the Roman Empire (first and fifth centuries B.C.), ceramics from the Iron Age, and samples from the 14th to 19th centuries. (JSR)

26376 APPLICABILITY OF THE SPECTRAL EMISSION ANALYSIS IN STUDIES CONNECTED WITH THE PROTECTION OF THE NATURAL AGRICULTURAL ENVIRONMENT. Glinski, J. (Inst. of Agrophysics, Lublin). pp 688-692 of Seventeenth International Conference on Spectroscopy. Vol. II. Milan; Associazione Italiana di Metallurgia (1973).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-P2.

The spectrographic method was used for the determination of the influence of industrial pollutions on the content of metallic elements in soils, plants, and water and to study the effectiveness of counteractions against this pollution. The powdered samples, taken from the vicinity of a zinc plant, were excited in an ac arc. The elements determined were Pb, Cr, Ni, Cu, V, B, Ti, Sr, Ba, Zn, Mo, Mn, and Fe. A considerably higher concentration of toxic elements occurred in the layers of the humus horizon than occurred in the same horizon of arable soils, where the top layer is systematically cultivated. The addition of lime to counteract the toxic materials reduced the uptake of Fe, Ba, Zn, Mn, Pb, and Cu by the soils. (JSR)

26377 ATOMIC ABSORPTION DETERMINATION OF METALLIC IMPURITIES IN SOLUTIONS OF HIGHLY ENRICHED URANIUM. Pagliai, V.; Pozzi, F. (CNEN, Saluggia, Italy). pp 726-731 of Seventeenth International Conference on Spectroscopy. Vol. II. Milan; Associazione Italiana di Metallurgia (1973). (In French).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-P2.

A method for the analysis of metallic impurities by atomic absorption is described. The impurities (Al, Ca, Cd, Fe, Li, Mg, Na, and Ni) are contained in solutions of highly enriched (90% ^{235}U) uranyl nitrate from the CNEN EUREX fuel reprocessing plant. The U matrix was separated by inverted phase partition chromatography using polytrifluoromonochloroethylene (Kel-F) in powder impregnated with TBP as the stationary phase and 5M HNO_3 as the eluant. The impurities, completely recovered, were determined with a spectrophotometer using either flame analysis or with a resistance furnace. The precisions and accuracies obtained with the two methods are shown in tabular form. The flame method gave a much higher error, but the precision was not too bad. (tr-auth)

26378 ATOMIC ABSORPTION OF MOLYBDENUM IN VARIOUS AIR–NITROUS OXIDE SUPPORTED ACETYLENE FLAMES. Stupar, J.; Dolinsek, F. (Institut Josef Stefan, Ljubljana, Yugoslavia). pp 802-808 of Seventeenth International Conference on Spectroscopy. Vol. II. Milan; Associazione Italiana di Metallurgia (1973).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-P2.

The atomization of Mo in various air–nitrous oxide–acetylene flames was studied. The influence of various flame parameters (flame gas composition, flame temperature, effective sample flow rate) on the sensitivity and atomization efficiency of Mo were determined. The atomization of Mo in chelate form by spraying an organic solvent into the flame was also studied. It was concluded from the results obtained that a mixture of air (70% v/v) and nitrous oxide (30% v/v) gave the highest sensitivity (0.17 μg/ml) in the determination of Mo in aqueous solutions. The sensitivity is at least three times better than that obtained in air–acetylene or nitrous oxide–acetylene flames. The sensitivity for Mo is principally dependent on the atomization efficiency and effective flow rate. Dilution of the analyte with the flame gases played a less important role than has been assumed. The variation of the absorption line width can be neglected for all practical purposes. The atomization efficiency of Mo in laminar acetylene flames is primarily dependent on the amount of excess acetylene; the temperature has a minimum effect. Variations of the sensitivity with respect to the organic spraying were chiefly the result of a variation of the effective flow rate and the state of atomization. The optimum conditions for the determination of Mo in the organic solvent composed of a mixture of oxine and methyl-isobutyl ketone are in the use of nitrous oxide–acetylene flames which gave the best absorption signal stability (detection limits of 0.02 μg Mo/ml. (tr-auth)

26379 SEVENTEENTH INTERNATIONAL CONFERENCE ON SPECTROSCOPY, FLORENCE, ITALY, SEPTEMBER 16–22,

1973. Volume III. Milan; Associazione Italiana di Metallurgia (1973). 194p. (In Several Languages). (CONF-730914-(P3)).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973).

In the third volume the eight plenary papers 29 of the contributed papers are compiled. Separate abstracts were written for four of the papers. (JSR)

For abstracts of individual papers see: 26380–26382 and 26465.

26380 DIRECT SPECTROCHEMICAL ANALYSIS (DC ARC) OF RARE EARTH TRACES IN SILICATE ROCKS AND MINERALS. Brenner, I. B. (Geological Survey of Israel, Jerusalem); Eldad, H.; Avni, R.; Harel, A. pp 139-144 of Seventeenth International Conference on Spectroscopy. Vol. III. Milan; Associazione Italiana di Metallurgia (1973).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-P3.

The volatilization rate and plasma variables in the spectrochemical analysis of rare earth traces in silicate rocks and minerals were studied and analyzed in order to develop a procedure that would give an accurate determination of these elements in these matrices. On the basis of the analysis, a procedure is adopted for the sample preparation, standard preparation, and excitation conditions that will give a sensitive method for rare earth traces. (JSR)

26381 HEAT TRANSFER EVALUATION IN DIFFERENT ATMOSPHERES OF A DC ARC PLASMA. Goldbart, Z.; Avni, R. (National Reactor Center Negev, Beer-Sheva, Israel). pp 145-148 of Seventeenth International Conference on Spectroscopy. Vol. III. Milan; Associazione Italiana di Metallurgia (1973).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-P3.

The effect of air, nitrogen, helium, and a mixture of Ar and O_2 used as the environmental atmosphere of a dc arc plasma in spectral analysis was studied on matrices of U_3O_8 and graphite. The atmosphere affects the phenomena occurring in the plasma and it affects the immediate vicinity of the plasma because of heat exchange processes by convection, radiation, and conduction. The results showed that the almost constant temperature in the anode region was independent of the atmosphere and the matrix in the anode crater. The temperatures of the central and cathode regions of the plasma with a U_3O_8 matrix are higher than those with graphite in air. The effect is weaker in Ar and does not exist in He. (JSR)

26382 HOLLOW CATHODE EXCITATION FOR THE DETERMINATION OF RARER ELEMENTS IN SOLUTION. Broekaert, O. A. C. (State Univ. of Ghent). pp 149-154 of Seventeenth International Conference on Spectroscopy. Vol. III. Milan; Associazione Italiana di Metallurgia (1973).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-P3.

The use of the hollow cathode as an excitation source for different metals in solution was studied. This technique is characterized by high stability in excitation and good reproducibility. For rare earths it offers the advantage of total absence of cyanogen bands. Detection limits can be improved by the addition of carrier salts and the optimization of the excitation conditions. The detection limits were calculated for solutions of Y, Yb, and Eu. The effect of the excitation conditions on the detection limits was also studied. (JSR)

26383 DIFFERENCE SPECTROPHOTOMETRIC DETERMINATION OF MICRO AMOUNTS OF METAL IONS IN MIXTURES. Naidu, P. P.; Rao, G. G. (Andhra Univ., Waltair, India). Microchem. J.; 18: No. 5, 520-528(1973).

The method permits simultaneous determination of Fe^{III} and Mo^{VI} (or Ti^{IV} or U^{VI}) and of Mo^{VI} and Ti^{IV} (or U^{VI}) in the same sample solution. To an aliquot of the solution are added 0.1M-Na acetate (5 ml) and 1% catechol solution (1 ml), and the mixture is diluted to 25 ml with H_2O. The extinctions are then measured at the appropriate wavelengths (listed) for the two specific metals, and the concentrations are calculated from these values and the ϵ values; the calculated and the observed extinction values are approximately equivalent. The calibration graphs are rectilinear for Fe, Mo, Ti, and U in the ranges (ppM—0.4 to 12, 0.8 to 24, 0.3 to 10, and 6 to 35, respectively. Tolerance levels for other cations are tabulated; SO_4^{2-}, Cl^-, and NO_3^- do not interfere seriously. The method can be applied also to ternary mixtures of, e.g., Fe, Ti and Mo. (Anal. Abstr.)

26384 REVIEW OF THE METHODS FOR THE DETERMINATION OF THE PLATINUM-GROUP METALS, SILVER, AND GOLD BY ATOMIC-ABSORPTION SPECTROSCOPY. Sen Gupta, J. G. (Geological Survey of Canada, Ottawa). Miner. Sci. Eng.; 5: No. 3, 207-218(Jul 1973).

A review of the atomic-absorption methods for the determination of the noble metals in various materials developed during the past fourteen years is presented. The means to overcome interferences from the matrix elements in aqueous and non-aqueous solutions and to improve the sensitivity of determination, as well as sample treatment (decomposition, separation, etc.), are thoroughly discussed with references to published materials. Applications of the methods to the determination of individual noble metals in specific materials, together with the operating parameters, are presented. (auth)

26385 USE OF STANDARDS IN THE QUANTITATIVE ELECTRON PROBE MICRO ANALYSIS OF BINARY METAL SYSTEMS. Bastin, G. F.; Heijwegen, C. P.; van Loo, F. J. F.; Rieck, G. D. (Eindhoven Univ. of Tech., Netherlands). Mikrochim. Acta; No. 4, 617-625(Jul 1974).

For the binary metal systems investigated, the Ziebold-Ogilvie relation has been found to be valid. It has been shown that polyphase alloys may be used as calibration standards if some specific conditions are fulfilled. In connection with a long-term instability of the microprobe apparatus, the Ziebold-Ogilvie constant of the calibration curve may vary with time. There is no reason for assuming that this instability is restricted to the particular instrument used. Therefore it is recommended that one or two standard alloys be used together with the pure reference metal to determine that constant every time concentration measurements have to be performed. The effect of the long-term instability can hardly be taken into account in the usual theoretically-based correction procedures. (auth)

26386 POLAROGRAPHY OF MOLYBDATE IN THE PRESENCE OF ORGANIC SULPHUR AND NITROGEN COMPOUNDS. I. The Electrochemical Behavior of Aqueous Acidified Solutions of Ammonium Molybdate With Thioacetamide. Farr, J. P. G.; Laditan, G. O. A. (Univ., Birmingham, Eng.). J. Less-Common Metals; 36: No. 1/2, 151-160(1974).

The polarography of acidified solutions of ammonium paramolybdate, thioacetamide and of their mixtures is described. Spectrophotometric absorption curves are given for the range 200 to 1000 nm. The polarographic curve for thioacetamide includes a small wave at $E_{\frac{1}{2}}$ −0.88 V (saturated calomel electrode), which is greatly enhanced at pH 3.0 by the presence of Mo(VI) ions and, to a lesser extent, by Mo(V). The nature of this wave is discussed and it is concluded that it is a catalytic hydrogen wave. Analytical applications are mentioned. (auth)

26387 DETERMINATION OF OIL IMPURITIES IN CO_2, USED AS A COOLANT IN GAS-COOLED REACTORS, BY THE METHODS OF IR AND UV SPECTROSCOPY. Ermolaev, M. I.; Savenko, L. G.; Goryachev, K. V.; Strel'nikova, I. B.; Kozyreva, E. F.; Kondratov, P. I.; Kirienko, T. I. Sov. At. Energy (Engl. Transl.); 34: No. 5, 477-478(May 1973).

Translated from At. Energ. (USSR); 34: No. 5, 391-392(May 1973). This is a summary of paper No. 664/6947 + 6948 with full copy held at TIC.

When carbon dioxide is used as a coolant in nuclear reactors, the need arises to determine impurities of mineral oils in the gas. The IR and UV absorption spectra of solutions of oils used in industrial carbon dioxide apparatuses, both new and after operation and subjection to temperature influences, pressure, and neutron irradiation, as well as samples of oils extracted from gas phases, were studied. It was established by the method of UV spectroscopy that: the first of the two maxima of the spectrum of oils, with greater intensity, corresponds to the wavelength ~230 nm, the second, with intensity ln $\epsilon \approx 3.3-3.5$, corresponds to the wavelength 257–261 nm in pentane, hexane, ethanol, and n-octane, and 265 nm in CCl_4. (LK)

26388 TITRIMETRIC DETERMINATION OF CHROMIUM(VI), MOLYBDENUM(VI), AND TUNGSTEN(VI) IN MIXED SOLVENTS USING NITCHROMAZO AS INDICATOR. Kreshkov, A. P.; Kuznetsov, V. V.; Mezhlumyan, P. G. (Moscow Chemico-Technological Inst.). Zh. Anal. Khim.; 29: No. 7, 1349-1352(Jul 1974). (In Russian).

. The effect of the nature and concentration of organic solvents has been examined on reactions between barium and CrO_4^{2-}, MoO_4^{2-}, HOW_4^- ions over their concentration range $10^{-3}-10^{-5}$ g-ion/l. The reactions proceed quantitatively in 80–90% acetone at initial aqueous solution concentration 4.0–5.5. Sensitive titrimetric methods have been developed for determining Cr(VI), Mo(VI), W(VI) which can be used for analysis of alloys and minerals. (auth)

26389 EXTRACTION-PHOTOMETRIC DETERMINATION OF MICROGRAM AMOUNTS OF TITANIUM IN ALUMINUM, IRON, CHROMIUM, NIOBIUM, TUNGSTEN, AND THESE METALS BASED

ALLOYS. Polyak, L. Ya. (All-Union Scientific-Research Inst. of Aircraft Materials, Moscow). Zh. Anal. Khim.; 29: No. 7, 1338-1343(Jul 1974). (In Russian).

Conditions were studied for determination of titanium (IV) as a ternary compound with diantipyrylmethane and stannous chloride extracted into chloroform. An extraction-photometric procedure was developed of determining titanium (down to $1 \cdot 10^{-4}$%) in aluminum, chromium, iron, niobium, tungsten, and these metal-based alloys (down to $1 \cdot 10^{-3}$% Ti). The coefficient of variation is 5.0. (auth)

26390 DETERMINATION AND SEPARATION OF SMALL AMOUNTS OF OSMIUM AND RUTHENIUM. Kadyrova, G. I.; Khvostova, V. P.; Shlenskaya, V. I.; Alimarin, I. P. (Moscow State Univ.). Zh. Anal. Khim.; 29: No. 7, 1389-1392(Jul 1974). (In Russian).

Optimal conditions have been developed for determining ruthenium by its catalytic action during the reaction of reducing nitric acid with α-naphthylamine. The determination sensitivity is $2 \cdot 10^{-3}$ μg/ml. The possibility has been elucidated of separation of small amounts of osmium and ruthenium by absorbing RuO_4 with 6 N hydrochloric acid. (auth)

26391 DETERMINATION OF TUNGSTEN IN THE PRESENCE OF NIOBIUM, TANTALUM, AND ORTHOPHOSPHORIC ACID BY USING AN ALTERNATING CURRENT POLAROGRAPH. Kurbatov, D. I.; Il'kova, S. B. (Ural Scientific Center, Sverdlovsk, USSR). Zh. Anal. Khim.; 29: No. 7, 1430-1433(Jul 1974). (In Russian).

The rate constant value of electrochemical reduction of W(VI), calculated from active and reactive components of the sell current in the presence of 9-10 M H_3PO_4, shows that the process is similar to a reversible one. This makes it possible to use alternating current polarographs for determining 0.1 to 10% W and more in metallic niobium, tantalum and their compounds. The relative standard deviation is not more than 3 to 14% at the tungsten contents of between 0.1 and 4.0%. (auth)

26392 DETERMINATION OF TANTALUM BY MEANS OF EXTRACTION WITH CRYSTAL VIOLET INTO BUTYL ACETATE. Malyutina, T. M.; Dobkina, B. M.; Egiazarova, N. V.; Kirillova, T. I. (State Scientific-Research and Design Inst. of Rare Metal Industry, Moscow). Zh. Anal. Khim.; 29: No. 7, 1429-1430(Jul 1974). (In Russian).

Extraction of crystal violet hexafluorotantalate into organic solvents was examined. Butyl acetate completely extracts tanalum in single extraction. Rapid methods were developed of determination of tantalum in loparite concentrate and titanium tetrachloride. (auth)

26393 SPECTROGRAPHIC ANALYSIS OF VANDIUM- AND ZIRCONIUM-BASED ALLOYS. Kornilova, O. A. (Donetsk Chemico-Metallurgical Prosessing Plant, USSR). Zh. Anal. Khim.; 29: No. 7, 1427-1428(Jul 1974). (In Russian).

Aluminum and silicon can be determined spectrographically in binary and multicomponent vanadium- and zirconium-based alloys by using a spark (determination of Al) and an arc (determination of Si) source of excitation. (auth)

26394 ANALYSIS OF SCANDIUM-CONTAINING MIXTURES BY COMPLEXOMETRIC AMPEROMETRIC TITRATION. Zhdanov, A. K.; Muminov, N. P. (Taskhent State Univ.). Zh. Anal. Khim.; 29: No. 7, 1424-1426(Jul 1974). (In Russian).

Successive amperometric titration of binary and ternary mixtures of scandium with some other elements is possible by using EDTA. Mixtures of cations Sc-Zn, Sc-Pb, Sc-Ca, Sc-Zn-Mg, Sc-La-Ca have been titrated. (auth)

26395 EMISSION SPECTROMETRIC DETERMINATION OF ISOTOPIC CONCENTRATIONS OF LITHIUM. Lichte, F.E.; Skogerboe, R.K. (Department of Chemistry, Colorado State University, Fort Collins, Colorado 80521). Appl. Spectrosc. 28: No. 4, 354-356 (July 1974).

Isotopic concentrations of lithium have been determined by emission spectrometry using an optical scanning method. Results indicate that the method provides results with a precision of 1%, relative standard deviation. (auth)

26396 CHEMICAL REACTIONS IN THE CARBON ELECTRODE CRATER DURING EMISSION SPECTROGRAPHIC ANALYSIS OF RARE EARTHS. Laktionova, N. V.; Ozhegov, P. I.; Karyakin, A. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 29: No. 7, 1327-1331(Jul 1974). (In Russian).

Chemical reactions have been studied in the carbon electrode crater during emission spectrographic analysis. It has been shown that the basic processes for rare earths in the crater proceed during blank sample combustion. The possibility has been examined of thermal dissociation, reduction with carbon, and formation and dissociation of rare earth dicarbides. Equations are suggested of temperature dependence of the vapor pressure of rare earth monoxides which are in equilibrium with corresponding oxides for the thermal dissociation. Equations are also suggested of temperature dependence of the vapor pressure of carbon monoxide in corresponding systems for the reduction with carbon and formation of rare earth carbides. The thermal dissociation of rare earth oxides to the monoxides only in the case of La_2O_3 give a marked contribution to the total component current transported into the gas phase at 2000°K in the electrode crater. (auth)

26397 ISOTOPIC ANALYSIS OF THE DEEP STRUCTURE IN THE TYRRHENIAN SEA. Cortecci, G.; Molcard, R.; Noto, P. (Univ., Pisa, Italy). Nature (London); 250: No. 5462, 134-136 (12 Jul 1974).

It is stated that the monotonic distribution of temperature and salinity with depth observed in most oceans is replaced in certain areas by a peculiar "staircase" structure in which sheets of water of constant temperature and salinity are separated by comparatively thin layers across which there is a sharp gradient. This structure is often associated with the intrusion of warm saline water into a colder and fresher water mass, and is present in the Tyrrhenian Sea below the inflow of the Levantine Intermediate Water through the Strait of Sicily. An attempt is described to distinguish the layers in that Sea by isotopic analysis of water samples collected from the different layers. Details are given of the sampling procedure, and the isotopic analysis procedure. The $^{18}O/^{16}O$ ratios in sulphate ions were measured using the graphite-reduction technique of Cortecci and Longinelli. Tritium analyses were also made; in the region of the stepped structure the T content decreased with depth, and interpretations of the T results are discussed. (UK)

26398 FLUORIMETRIC ROUTINE DETERMINATION OF URANIUM IN URINE SAMPLES. Widua, L.; Schieferdecker, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Medizinische Abt.); Hezel, U. (Zeiss (C.), Oberkochen (F. R. Germany). Abt. fuer Physikalisch-Chemische Analyse). Z. Anal. Chem.; 270: No. 1, 12-15(Jun 1974). (In German).

2 figs.; 1 tab.; 6 refs.

With a modified RA 2 reflectance accessory for the Zeiss PMQ II/PMQ 3 spectrophotometer, uranium in urine was detected with higher sensitivity. A routine method is now available with a detection limit of <2 ωg U/l urine for the determination of possible uranium incorporations, whose sensitivity meets the requirements of radiation protection. Compared with other extraction methods, the instrument outlay and the required working time are small. The total error of the method is below 5%. (auth)

26399 TRACE ENRICHMENT WITH ACTIVATED CARBON-DETERMINATION OF TRACES OF ELEMENTS IN POWDERED TUNGSTEN. Jackwerth, E.; Lohmar, J.; Wittler, G. (Institut fuer Spektrochemie und Angewandte Spektroskopie, Dortmund (F. R. Germany)). Z. Anal. Chem.; 270: No. 1, 6-9(Jun 1974). (In German).

2 tabs.; 5 refs.

A method is described for the enrichment of traces of Ag, Cd, Co, Cu, In, Ni, Pb, Tl, and Zn in powdered tungsten. For this purpose, the elements are complexed with sodium diethyldithiocarbamidate (NaDDTC) after dissolving the sample in H_2O_2. By filtration of the sample solution through a filter paper coated with activated carbon the chelate compounds are adsorbed and enriched at the surface of the carbon particles. The enriched elements are determined by x-ray fluorescence spectrometry or, after treating the carbon collector with nitric acid, by atomic absorption spectrometry. The relative standard deviation for different elements was found to be between 0.02 and 0.16. The limit of detection is 0.04 to 2.3 ppM. (auth)

26400 POLAROGRAPHIC DETERMINATION OF URANIUM IN THE PRESENCE OF HIGH AMOUNTS OF PHOSPHATE. Csagoly, E. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszsegugyi Kutato Intezet, Budapest (Hungary)). Z. Anal. Chem.; 270: No. 1, 9-12(Jun 1974). (In German).

3 figs.; 4 refs.

The method developed by Susic and Gyorbiro makes possible the polarographic determination of uranium even under a high phosphate content (e.g. the analysis of superphosphate), provided that following the reduction of the contaminating ions by ascorbic acid the solution is reneutralized to pH 0.10. Amounts on the order of 20-100 ωg of U/ml were determined with an accuracy of ±5%. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 26516, 26866, 26890, 26920, 26932, and 26968.

26401 (BNWL-tr-127) LIQUID SCINTILLATION COUNTING OF ALPHA EMITTERS. Lefeore, H.; Godement, A. Translated by E. R. Appleby from Radiochem. Radioanal. Lett.; 17: No. 3, 197-205(1974). 8p. Dep. NTIS $4.00.

The feasibility of the use of liquid scintillation counting of α emitters was tested on ^{239}Pu solutions in HCl, HNO_3, and H_2SO_4 solutions for six different liquid scintillation mixtures. In HNO_3 medium there was a noticeable counting loss with all mixtures tested. Various mixtures of Pu and ^{241}Am were then tested on PBD plus Triton in toluene. An attempt to discriminate the energies of the α rays of all the isotopes of Pu, ^{237}Np, and ^{241}Am was unsuccessful, but it was possible to discriminate the β from ^{241}Pu from the α rays of the other Pu isotopes. In summation, all the α rays of $^{239,240,242}Pu$ and ^{241}Am, the β rays of ^{241}Pu, and the amount of ^{241}Am (by γ counting) can be determined in a flask using liquid scintillation counting. (tr-auth)

26402 (CEA-R-4564) THIN LAYER CHROMATOGRAPHY FOR THE SEPARATION AND EVALUATION OF PURIC BASES AND THEIR NUCLEOSIDES. Chivot, J. J.; Leibbrandt, M.; Rouvroy, H.; Simeon, J.; Caen, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). Jul 1974. 18p. (In French). Dep. NTIS (US Sales Only) $4.00.

A method of thin-layer chromatography and liquid scintillation suitable for the separation and the evaluation of nucleotides, nucleosides and puric bases is described. The procedure employs PEI-cellulose plates with migration in two dimensions. The identification of the separated constituents employs radioactivity of ^{14}C or ultraviolet light. The radioactive compounds are evaluated by liquid scintillation counting. This technique offers: ease of manipulation, use of small quantities of material, highly consistent and reproducible results, good separation of the individual compounds. An application of this technique to a plasma system is proposed. A study of platelet's metabolites is realized at present in the laboratory with this method. (auth)

26403 (CONF-730907-P1, pp 532-537) RAPID DETERMINATION OF THE TRANSURANIUM ELEMENTS BY EXTRACTION CHROMATOGRAPHY IN URINES CONTAINING DTPA. Delle Site, A.; Santori, G.; Testa, C. (CNEN, Rome). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Microporous polyethylene (Microthene-710) supporting tri-n-octylphosphine oxide (TOPO) and di(2-ethylhexyl) phosphoric acid (HDEHP) has been used successfully to extract respectively Th, Pa, U, Np, Pu, Am, and Cm from the urine. As the extraction takes place in an HNO_3 medium, DTPA up to 2 g/l does not interfere. A particular investigation was carried out for Am in order to find out the best extraction pH. Finally it has been demonstrated that great losses of actinides occur when a coprecipitation with Ca and Mg phosphates are carried out in the presence of DTPA. (auth)

26404 USE OF X-RAY FLUORESCENCE FOR CHEMICAL ANALYSIS. Owers, M. J. (Central Electricity Generating Board, London); Shalgosky, H. I. J. Phys., E (London); 7: No. 8, 593-603 (Aug 1974).

Major advances in x-ray fluorescence analysis during the last three years are reviewed. Considerable progress has been noted in the use of radioactive sources, small x-ray tubes and energy analysis by solid state detectors. Much of the review deals with published applications of x-ray fluorescence in chemical analysis. An attempt is made to forecast future developments and comparison with other analytical techniques suggest that x-ray fluorescence spectrometry will maintain, and possibly increase, its relative importance. (auth)

26405 SILICATE ANALYSIS BY MEANS OF AUTOMATED X-RAY FLUORESCENCE SPECTROMETRY. Gricius, A. J.; Wybenga, F. T. (South African Council for Scientific and Industrial Research, Pretoria). pp 475-479 of Seventeenth International Conference on Spectroscopy. Vol. II. Milan; Associazione Italiana di Metallurgia (1973).

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-P2.

In the analysis of silicate samples by x-ray fluorescence spectroscopy the matrix effects can be eliminated by fusion of the sample with a suitable flux or by mathematical corrections. Comparisons were made of the powder and fusion methods. Mathematical corrections for interelement effects were reported. The results for both methods were shown to have the same accuracy and precision. Examples of applications were given for various types of samples, including lunar material. (tr-auth)

26406 STRONTIUM, CESIUM, IODINE, AND BARIUM DETERMINATIONS IN SAMPLES BY ION-INDUCED X-RAY FLUORESCENCE. Russell, J. P. Gainesville, FL; Univ. of Flordia (1973). 130p. University Microfilms Order No. 74-19,180.

Thesis (Ph. D.).

The relative merits of alpha particles and protons, as well as the effect of projectile energy, were studied over the energy range of 2 to 7 MeV. The alpha particles were found to offer advantages over protons in this application. A routine procedure for the measurement of trace elements in biological samples has been developed using solid "infinitely thick" targets for the projectiles. The procedure is believed to be readily adaptable into a program for the preoperational surveillance of a nuclear facility. Determinations of strontium, iodine, cesium, and barium in the parts per million range have been accomplished in a variety of biological samples. A representative spectrum of samples suitable to this application including sea water, fish, algae, and others has been examined quantitatively. Water and vegetation from a fresh-water cooling lake for an operating nuclear power plant have been examined to demonstrate the effectiveness of the technique for other types of samples. The results of the measurements have been applied to calculations yielding the expected exposures from the Florida Power Corporation's nuclear facility, Crystal River Unit 3, now under construction. The value of trace element analysis in preoperational surveillance of nuclear facilities is demonstrated. (Diss. Abstr. Int., B)

26407 X-RAY FLUORESCENCE SPECTROGRAPHIC ANALYSIS OF FILMS OF COMPLEX COMPOSITION. Darashkevich, V. P.; Malyukov, B. A. Zh. Anal. Khim.; 29: No. 7, 1316-1322 (Jul 1974). (In Russian).

A multipurpose x-ray fluorescence method has been suggested and developed for determining the composition and thickness of thin films of complex composition. The method is based on using mono-element calibration samples. Approximated formulas have been derived for calculation of the surface density of the element to be determined in a three-component film. The formulas take into account the effects of x-ray absorption in analyzed and calibration film samples and make it possible to calculate the composition and thickness of the films analyzed with enough practical accuracy. The x-ray spectrographic analysis has been carried out of films with the thickness of 0.1-3 μm which composition varies over a wide range. The x-ray analysis results are in good agreement with those obtained by using other methods of determining the film composition and thickness. (auth)

26408 ANALYSIS OF SURFACE LAYERS WITH THE AID OF ABNORMAL α-PARTICLE SCATTERING. Kuznetsov, B. I.; Chernov, I. P.; Starodub, G. Ya.; Yatis, A. A. Sov. At. Energy (Engl. Transl.); 35: No. 6, 1147-1149(Dec 1973).

Translated from At. Energ. (USSR); 35: No. 6, 439-441(Dec 1973).

A method for determining the concentration of light elements is proposed, based on anomalies in the backscattering of α particles. The entire information on the depth at which admixture elements are situated is related to the ionization losses of the scattered particles. Data for niobium and germanium are given as examples. C, O, and N can be determined at various depths in samples. (MCG)

26409 DETERMINATION OF THE AMOUNT OF TRITIUM IN ORGANIC MATERIALS ACCORDING TO BREMSSTRAHLUNG. Belovodskii, L. F.; Gaevoi, V. K.; Grishmanovskii, V. I. Sov. At. Energy (Engl. Transl.); 35: No. 6, 1150-1152(Dec 1973).

Translated from At. Energ. (USSR); 35: No. 6, 441-443(Dec 1973).

A rapid and nondestructive method for determining the amount of tritium in organic film materials is discussed. The method is based on the rate of count of bremsstrahlung due to the β-particles of the decay of tritium. (LK)

26410 NONDESTRUCTIVE DETERMINATION OF TRITIUM CONTENT OF ERBIUM TRITIDE THIN FILMS AU JOHN E., Pearson, J.E. (Neutron Devices Department, General Electric Company, St. Petersburg, Florida 33733). Appl. Spectrosc. 28: No. 4, 358-361 (July 1974).

The x-ray spectrum resulting from beta decay of an erbium tritide film is used to measure tritium content of the film. The areal density of the film is measured using differential emission techniques and is used to correct the measured x-ray intensity for self-absorption. The

corrected intensity is linearly related to tritium content through an empirically derived calibration curve. The technique will measure tritium contents from less than one to several hundred micron liters. Repeatability is generally determined by counting errors and is typically 0.3% for a 3-min count while accuracy depends upon the empirical calibration technique. In principle, the technique is not limited to erbium tritide but can be extended to many uniformly radiating thin films. (auth)

26411 GAS PHASE RADIOANALYTICAL METHOD AND APPARATUS. Mlinko, S.; Banfi, D.; Dobis, E.; Ottinger, J.; Payer, K.; Palagyi, T.; Turi, A. (to Gyogyszerkutato Intezet and Kozponti Kemiai Kutato Intezet). US Patent 3,832,137. 27 Aug 1974. Priority date 14 Sep 1970, Hungary. 8p.

Process and apparatus for the automatic and continual gas phase determination of the radioactivity of a substance labeled with ^{14}C isotope is described. It involves oxidizing the substance to $^{14}CO_2$ with excess oxygen, removing the unconsumed oxygen as water after reaction with hydrogen and transporting the $^{14}CO_2$ to a detector for radioactive counting. (Official Gazette)

26412 PROBLEMS ENCOUNTERED IN THE USE OF NEUTRON METHODS FOR ELEMENTAL ANALYSIS ON PLANETARY SURFACES. Senftle, F.; Philbin, P.; Moxham, R.; Boynton, G. (U. S. Geological Survey, Reston, Virginia 22092, U. S. A.); Trombka, J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Nucl. Instrum. Methods; 117: No. 2, 435-443(15 May 1974).

From experimental studies of gamma rays from fast and thermal neutron reactions in hydrogeneous and non-hydrogeneous, semi-infinite samples and from Monte Carlo calculations on soil of a composition which might typically be encountered on planetary surfaces, it is found that gamma rays from fast or inelastic scattering reactions would dominate the observed spectra. With the exception of gamma rays formed by inelastically scattered neutrons on oxygen, useful spectra would be limited to energies below 3 MeV. Other experiments were performed which show that if a gamma ray detector were placed within 6 m of an isotopic neutron source in a spacecraft, it would be rendered useless for gamma ray spectrometry below 3 MeV because of internal activationa produced by neutron exposure during space travel. Adequate shielding is not practicable because of the size and weight constraints for planetary missions. Thus, it is required that the source be turned off or removed to a safe distance during nonmeasurement periods. In view of these results an accelerator or an off-on isotopic source would be desirable for practical gamma ray spectral analysis on planetary surfaces containing but minor amounts of hydrogen. (auth)

26413 THIN LAYERS COMPOSITION AND IMPURITIES DETERMINATION USING LOW ENERGY PROTON X-RAY EXCITATION. Applications to Chalcogenide Films Stoichiometry and Boron Purification Control. Thomas, J. P.; Porte, L.; Engerran, J.; Viala, J. C.; Tousset, J. (Inst. de Physique Nucleaire, Villeurbanne, France). Nucl. Instrum. Methods; 117: No. 2, 579-587(15 May 1974).

Proton x-ray excitation below 4 MeV has been used for the analysis of thin films for the determination of compound composition as well as for the control of the content of impurities ($Z > 13$) in a pure element. Stoichiometry determination of chalcogenide glasses (Ge, As, Te, S) and multi-elemental analysis of evaporated boron layers are performed under experimental conditions which are described in each case, but without significant changes in the detection and irradiation system. Specific problems of these two different purposes, such as precision, reproducibility and sensitivity are considered showing the reliability of the method. Its applications both for solid-state physics and inorganic chemistry are discussed. (auth)

26414 PHOTON SELF-ABSORPTION EFFECTS: A POTENTIALLY LARGE ERROR IN PASSIVE GAMMA-RAY ASSAYS. Forster, R. A.; Umbarger, C. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 117: No. 2, 597-598 (15 May 1974).

A simple technique is presented which can be used to quantify the self-absorption of photons emitted from a radioactive particle. As an example the fraction of photons which escape a spherical particle without collision is shown for plutonium metal spheres of various sizes. (auth)

26415 MEASUREMENT OF LOW LEVELS OF NORMAL URANIUM IN WATER AND URINE BY LIQUID SCINTILLATION ALPHA COUNTING. Horrocks, D. L. (Beckman Instruments, Inc., Fullerton, Calif. (USA)). Nucl. Instrum. Methods; 117: No. 2, 589-595(15 May 1974).

The amounts of normal uranium in water and in urine have been measured as low as 0.1 $\mu g/ml$ (6×10^{-8} $\mu Ci/ml$) by liquid scintillation counting methods. An emulsifier system was used to incorporate up to 5 ml of an aqueous solution in a 15 ml counting solution (10 ml of scintillation cocktail plus 5 ml of aqueous solution) with 100% counting efficiency for the alpha particles from the ^{234}U, ^{235}U and ^{238}U radionuclides. Use of a multi-channel analyzer allows corrections for the presence of short-lived beta emitters in the uranium decay chain. (auth)

Separation Procedures

Refer also to abstracts 26452, 26542, and 27401.

26416 (IEA-311) EDTA, COPPER, AND RARE EARTH RECOVERY FROM Cu-EDTA-RE-EDTA SOLUTIONS. Use of Thiourea as in situ H_2S Generator. Abrao, A. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Sep 1973. 9p. Dep. NTIS (US Sales Only) $4.00.

A technique of homogeneous precipitation using the hydrolysis of thiourea as a H_2S source for the break up of Cu-EDTA chelate and copper sulfide precipitation is presented. The technique is simple and has some advantages for the recovery of the valuable products EDTA, copper, and rare earths, avoiding the inconvenience of H_2S smell. (auth)

26417 SOLVENT EXTRACTION OF TELLURIUM(IV) WITH MESITYL OXIDE. Direct Nephelometric Determination. Dhond, P. V.; Khopkar, S. M. (Indian Inst. of Tech., Bombay). Mikrochim. Acta; No. 4, 721-727(Jul 1974).

A fast and selective method was developed for the extraction of tellurium(IV) with mesityl oxide. Tellurium(IV) is quantitatively extracted by pure mesityl oxide from 2.5 to 3 M hydrochloric acid solutions. After stripping with water, it is determined nephelometrically as the bluish sol. The extracted species probably has the composition $TeCl_4 \cdot 2$ MeO. The optimum period of equilibration is 30 seconds. Tellurium can be extracted and determined in the presence of a large excess of selenium, silver, bismuth, lead, copper, and nickel, which are associated with it in minerals. (auth)

26418 SOLVENT EXTRACTION OF RUBIDIUM AND CAESIUM WITH POLAR ORGANIC SOLVENTS. Kyrs, M. (Ustav Joderneho Vyzkumu, Rez, Czech.); Benesova-Pacltova, M.; Maksimovic, Z. B.; Maddock, A. G. J. Inorg. Nucl. Chem.; 36: No. 8, 1865-1870(Aug 1974).

Values of the equilibrium constant characterizing the solvent extraction of rubidium and cesium ions from aqueous solution, by ion exchange with hydrogen or sodium ions present in an organic phase, with chloroferrate(III) or dipicrylamine as counter anions, were determined for solutions of 2,4-dinitrofluorobenzene and 2,4-dinitrochlorobenzene. (auth)

26419 EXTRACTION OF POLYMOLYBDATES(VI) FROM AQUEOUS SOLUTION BY TRI-N-OCTYLAMINE HYDROCHLORIDE IN CHLOROFORM. Bullock, J. I.; Pathak, R.; Rusheed, A.; Salmon, J. E. (Univ. of Surrey, Guilford, Eng.). J. Inorg. Nucl. Chem.; 36: No. 8, 1881-1885(Aug 1974).

Iso-polymolybdates and protonated species with the general formula $H_xMo_nO_y^{z-}$ were extracted from aqueous acid solutions by tri-n-octylamine hydrochloride in chloroform. The ratio n:z (the R value) was determined by chemical analysis, and vapor pressure lowering studies on the organic phase allowed direct calculation of n and z. Continuous polymerization in the pH range 1 to 5 was observed with ions of n = 6 and 10 persisting through the pH ranges 4 to 5 and 2 to 2.5, respectively. Two possible schemes for the formation of 6-ions and the possible conversion of these to 7-, 8-, and 10-ions are discussed. (auth)

26420 CATIONIC COMPLEXES OF EUROPIUM AND NEODYMIUM WITH 2-METHYL-8-HYDROXYQUINOLINE. Shakhova, N. V.; Kiseleva, O. A.; Zolotov, Yu. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 29: No. 6, 1229-1231(Jun 1974). (In Russian).

A coordinatively unsaturated chelate anion is formed during a reaction between europium (neodymium) and 2-methyl-8-hydroxyquinoline. The complex can be extracted only in the presence of a suitable anion. The extraction depends on the solvent nature. (auth)

26421 DEPENDENCE OF THE RELATIONSHIPS OF SORPTION OF MOLECULAR IODINE IN THE LIQUID PHASE BY AV-17 ANION-EXCHANGE RESIN ON THE CONCENTRATION OF CHLORIDE SOLUTIONS CONTAINING IODINE. Kazakov, E. V.; Gubanova, L. S. J. Appl. Chem. USSR (Engl. Transl.); 47: No. 2, 267-269(Feb 1974).

Translated from Zh. Prikl. Khim.; 47: No. 2, 264-267(Feb 1974).

Study of sorption of iodine by AV-17 × 8 anion-exchange resin showed that the equilibrium iodine concentrations C_{I_2} after sorption are in good agreement with results of calculations based on the instability constants of the complex $[I_2Cl]^-$; this completely confirms the suggestion that the complex polyhalide ion is not sorbed by AV-17 resin. This accounts for the decrease of sorption of iodine by the resin on increase of chloride-ion concentration in the solution. (auth)

26422 REVIEW OF THE USE OF CARBOXYLIC ACIDS AS EXTRACTANTS FOR THE SEPARATION OF METALS IN COMMERCIAL LIQUID–LIQUID EXTRACTION OPERATIONS. Ashbrook, A. W. (Dept. of Energy, Mines, and Resources, Ottawa). Miner. Sci. Eng.; 5: No. 3, 169-180(Jul 1973).

The use of aliphatic monocarboxylic acids as extractants for the separation of metals by liquid–liquid extraction is reviewed. The use of these reagents in commercial liquid–liquid extraction processes is examined, and conclusions drawn as to their applicability. (auth)

26423 SEPARATION OF MICROAMOUNTS OF OSMIUM, RUTHENIUM, AND IRIDIUM. Ivonov, V. P.; Potapova, S. A.; Dubrovina, Z. N. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Anal. Khim.; 29: No. 7, 1393-1397(Jul 1974). (In Russian).

Optimal conditions have been found for isolation of osmium and ruthenium microamounts by using distillation of OsO_4 and RuO_4. Osmium is separated from a mixture of HCl and HNO_3 (volume ratio 10 : 1), ruthenium from 56% $HClO_4$ solution. Iridium is not distilled off. The analysis takes 50–60 min. (auth)

26424 EXTRACTION OF A MOLYBDENUM(V) COMPOUND WITH THIOGLYCOLIC ACID FROM HYDROCHLORIC ACID SOLUTIONS INTO OXYGEN-BEARING SOLVENTS. Busev, A. I.; Dzintarnieks, M. E.; Rudzit, G. P. (Moscow State Univ.). Zh. Anal. Khim.; 29: No. 7, 1353-1361(Jul 1974). (In Russian).

The extraction of a compound of molybdenum(V) with thioglycolic acid follows the solvent order: alcohols > ketones > esters. The compound is probably extracted via the hydrate-solvate mechanism. Association constants between the complex anion and the proton in the aqueous phase and two-phase, stability constants for ten oxygen-bearing extractants were determined. The effect of various diluents on extraction of molybdenum(V) compounds with oxygen-bearing solvents was elucidated. Probable reasons for the synergistic effect are discussed. (auth)

26425 SORPTION OF ACTINIUM FROM MIXED SOLVENTS ON AN ANION EXCHANGER IN THE PRESENCE OF CHLORIDE IONS. Karalova, Z. K.; Myasoedov, B. F.; Rodionova, L. M.; Pyzhova, Z. I. (Inst. of Geochemistry and Analytical Chemistry Moscow). Zh. Anal. Khim.; 29: No. 7, 1332-1337(Jul 1974). (In Russian).

Sorption of actinium has been examined as a function of the nature and content of the organic component, medium acidity, chloride ion concentration. Actinium is sorbed by anion exchanger AV-17 × 8 from hydrochloric solutions in the presence of acetone and *n*-propanol with high distribution coefficients. It has been established that actinium forms with chloride ions a complex $AcCl_4^-$. The effect of the composition of an acetone–ethanol–HCl mixture has been studied on the distribution coefficients of Ac, Th, rare earths, Bi, Pb. Conditions were determined for separation of Ac from daughter products (Th, Bi, Pb) and a microimpurity of Fe. (auth)

26426 SOLVENT EXTRACTION RECOVERY OF HIGH-PURITY AMMONIUM PARAMOLYBDATE FROM NORMAL ALKALI MOLYBDATE SOLUTION. MacInnis, M. B.; Kim, T. K.; Laferty, J. M. (GTE Sylvania Inc., Towanda, PA). J. Less-Common Metals; 36: No. 1/2, 111-116(1974).

The extraction of molybdenum into tri-*n*-caprylyl amine from aqueous sodium molybdate solutions has been studied at both tracer and macro-concentrations. The type of molybdenum species and the mechanism involved in the extraction were determined and a process for the production of pure ammonium paramolybdate, free of cationic and anionic impurities, was developed. (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 26510, 26525, 27346, 27350, 27388, 27537, 28657, and 28666.

26427 (ORO-2907-92) STUDIES IN THE PHYSICAL CHEMISTRY OF SELECTED HIGH TEMPERATURE SYSTEMS. Final Report, March 1, 1966–May 31, 1972. Margrave, J. L. (Rice Univ., Houston, Tex. (USA)). 1972. Contract AT(40-1)-2907. 15p. Dep. NTIS $4.00.

Two accomplishments during the contract period were: (1) the successful kinetic study of an oriented molecular beam reaction, and (2) the development of the new technique of levitation calorimetry, which allows determination of heats of fusion, enthalpy increments, and heat capacities for the very refractory metals such as Ti, V, Fe, Co, Ni, Cu, Zr, Nb, Mo, Pd, and Pt. These values are given in the report. A list of publications is included. (LK)

26428 NEW SYNTHETIC APPROACHES TO GRAPHITE–FLUORINE CHEMISTRY. Lagow, R. W.; Badachhape, R. B.; Wood, J. L.; Margrave, J. L. (Rice Univ., Houston, TX). J. Chem. Soc., Dalton Trans.; No. 12, 1268-1273(1974).

New methods for synthesizing poly(carbon monofluoride) $(CF_x)_n$ and tetracarbon monofluoride C_4F are reported. Pyrolytic graphite has been fluorinated and a new compound, graphite oxyfluoride, has been prepared. Poly(carbon monofluoride) has been prepared in a flow reactor, in a fluidized-bed reactor, and a high-pressure bomb reactor and tetracarbon monofluoride has been prepared by a high-pressure bomb technique. Some new structural data are presented for poly(carbon monofluoride). Recently, poly(carbon monofluoride) has been found to have a high potential as a solid lubricant and as a cathode material in high-energy batteries. (auth)

26429 CAUSES OF LOW MOLYBDENUM CONTENTS IN ELECTROLYTIC CHROMIUM–MOLYBDENUM ALLOY. Shluger, M. A.; Osobenkova, E. N.; Shirokova, N. V. J. Appl. Chem. USSR (Engl. Transl.); 47: No. 2, 358-360(Feb 1974).

Translated from Zh. Prikl. Khim.; 47: No. 2, 359-361(Feb 1974).

Absence of trivalent chromium ions in the cathodic films formed on the cathode in chromium electrolytes with addition of molybdate ions indicates that in this case the main components of the cathodic films are complex compounds of molybdenum in a low oxidation state. The low molybdenum contents in electrolytic chromium–molybdenum alloys are evidently due to the fact that the greater proportion of molybdate ions is reduced to an intermediate oxidation state and retained in the cathodic film. (auth)

26430 RADIOCHEMICAL INVESTIGATION OF THE ANODIC DISSOLUTION OF NICKEL WITH THE ISOTOPE ^{35}S. Krupski, J.; Feller, H. G. Z. Metallk.; 65: No. 5, 401-407(May 1974). (In German).

9 figs.; 1 tab.; 11 refs.

The anodic dissolution of nickel is investigated by electro- and radiochemical methods. A competitive adsorption is found between the OH^- ions, which activate the dissolution, and the SO_4^{2-} ions, which inhibit the dissolution in the prepassive region. Chloride and iodide ions are adsorbed specifically and block the surface sites for the adsorption of the OH^- and SO_4^{2-} ions. (auth)

26431 ENTHALPY OF FORMATION OF $W(CO)_6$. Barnes, D. S.; Pilcher, G.; Pittam, D. A.; Skinner, H. A.; Todd, D. (Univ. of Manchester, Eng.). J. Less-Common Metals; 38: No. 1, 53-58 (Oct 1974).

Measurements of the energy of combustion of tungsten hexacarbonyl in oxygen gas at 298°K by static bomb calorimetry are reported. Independent measurements of the enthalpy of thermal decomposition of the hexacarbonyl were also made, using a "hot-zone" reaction calorimeter. Values of the standard enthalpy of formation, at 298°K, of crystalline tungsten hexacarbonyl, derived from the two independent thermochemical studies, agree; the mean value is: $\Delta H_f^\circ[W(CO)_6, c] = -229.5 \pm 0.7$ kcal mol^{-1}, or -960.3 ± 2.9 kJ mol^{-1}. (auth)

26432 APPLICATION OF THE RADIOTRACER METHOD FOR THE STUDY OF ELECTROSORPTION OF CARBON DIOXIDE ON PLATINUM. Czerwinski, A.; Sobkowski, J.; Wieckowski, A. (Univ., Warsaw). Int. J. Appl. Radiat. Isotop.; 25: No. 7, 295-300(Jul 1974).

An apparatus for the study of carbon dioxide adsorption (labelled with ^{14}C) on platinum electrodes from 0.5 M H_2SO_4 solution has been developed. The working electrode was prepared by the electroplating of gold, deposited onto a mylar foil. A plastic scintillator was placed under the electrode to achieve a high counting efficiency (~15%). Owing to the construction of the apparatus the study of adsorption dependence on temperature was made possible. It has been shown that the CO_2 adsorption on platinum (in the potential range 0 to 0.35 eV) is a result of interaction with H_{ads}. The surface concentration of "reduced CO_2" on platinum, and the

charge needed for its oxidation reveal that the adsorbed species is a COOH radical. (auth)

26433 LITHIUM–LITHIUM HYDRIDE SYSTEM. Veleckis, E.; Van Deventer, E. H.; Blander, M. (Argonne National Lab., IL). J. Phys. Chem.; 78: No. 19, 1933-1940(12 Sep 1974).

Equilibrium hydrogen pressures (P_{H_2}) of lithium–lithium hydride mixtures sealed in iron capsules were measured over the following temperature-pressure-composition ranges: 710 to 903°, 0.5 to 760 Torr, and 0.5 to 99 mol % LiH. The isotherms show the phase diagram to consist of two homogeneous terminal solutions separated by a miscibility gap whose boundaries range from 25.2 and 98.4 mol % LiH at 710° to 45.4 and 85.5 mol % LiH at 903°. The data were fitted by a consistent thermodynamic treatment using the Margules forms for the activity coefficients. For each homogeneous solution region, this treatment yielded analytical expressions for the chemical potentials and activity coefficients of each species. The data show strong positive deviations from ideality of the solute species, especially in the LiH-rich solutions, where they may be related to the associative tendency of the lithium atoms. For dilute solutions of LiH in lithium, the ratio $N_{LiH}/(P_{H_2})^{\frac{1}{2}} = K'$ is given by $K'(atm^{-\frac{1}{2}}) = \exp(-6.498 + 6182T^{-1})$, where N_{LiH} is the mol fraction of LiH and T is the Kelvin temperature. For dilute solutions of Li in liquid LiH, the distribution of lithium between the gas and the solution phases is heavily weighted in favor of the latter, reflecting strong interactions between Li atoms and liquid LiH. The standard free energy of formation of liquid LiH is given by ΔG_f° (kcal/mol) = $13.47 \times 10^{-3}T - 16.55$. (auth)

26434 PREDICTED PROPERTIES OF THE SUPERHEAVY ELEMENTS. III. Element 115, Eka-Bismuth. Keller, O. L. Jr. (Oak Ridge National Lab., TN); Nestor, C. W. Jr.; Fricke, B. J. Phys. Chem.; 78: No. 19, 1945-1949(12 Sep 1974).

Element 115 is expected to be in group V-a of the periodic table and have most stable oxidation states of I and III. The oxidation state of I, which plays a minor role in bismuth chemistry, should be a major factor in 115 chemistry. This change will arise because of the large relativistic splitting of the spherically symmetric $7p_{\frac{1}{2}}$ shell from the $7p_{\frac{3}{2}}$ shell. Element 115 will therefore have a single $7p_{\frac{1}{2}}$ electron outside a $7p^2_{\frac{3}{2}}$ closed shell. The magnitude of the first ionization energy and ionic radius suggest a chemistry similar to Tl^+. Similar considerations suggest that 115^{3+} will have a chemistry similar to Bi^{3+}. Hydrolysis will therefore be easy and relatively strongly complexing anions of strong acids will be needed in general to effect studies of complexation chemistry. Some other properties of 115 predicted are as follows: ionization potentials I 5.2 eV, II 18.1 eV, III 27.4 eV, IV 48.5 eV, $0 \rightarrow 5^+$ 159 eV; heat of sublimation, 34 kcal (g-atom)$^{-1}$; atomic radius, 2.0 Å; ionic radius, 115^+ 1.5 Å, 115^{3+} 1.0 Å; entropy, 16 cal deg^{-1} (g-atom)$^{-1}$ (25°); standard electrode potential $115^+|115$, −1.5 V; melting and boiling points are similar to element 113. (auth)

Isotope Effects

Refer also to abstracts 26462, 26466, 26477, and 28103.

26435 ISOTOPE EFFECTS IN THE QUENCHING OF ELECTRONICALLY EXCITED ATOMS: PHOTOLYSIS OF CD_3I. Donovan, R.J.; Fotakis, C. (Department of Chemistry, University of Edinburgh, West Mains Road, Edinburgh, Scotland). J. Chem. Phys. 61: No. 5, 2159-2160 (1 Sept 1974).

The deuterium effect on the quenching of I ($5\ ^2P_{1/2}$) by iodoform is measured using time resolved atomic absorption spectroscopy. The results show that isotopic substitution can lead to a large change in the relative quenching efficiency. (AIP)

26436 DIELECTRIC CONSTANT, REFRACTIVE INDEX, ATOMIC POLARIZATION, AND DIPOLE MOMENT DERIVATIVES OF HEXAMETHYLENETETRAMINE–h_{12} AND –d_{12}. Bertie, J.E.; Solinas, M. (Department of Chemistry, University of Alberta, Edmonton, Canada). J. Chem. Phys. 61: No. 5, 1678-1679 (1 Sept 1974).

The frequencies of the longitudinal and transverse components of the infrared–active modes of hexamethylenetetramine–h_{12} and –d_{12} have been used to determine the static dielectric constant and the dipole moment derivatives, using the refractive index. The sodium–D refractive index and the static dielectric constant of HMT–d_{12} are the same as those of HMT–h_{12}, within experimental error. The static dielectric constant is 2.67±0.05 and the atomic polarization is 2.8 ±0.7 cm^3. The dipole moment derivatives are listed for seven of the nine infrared–active modes of each molecule. (auth)

26437 INFRARED AND RAMAN SPECTRA AND THE VIBRATIONAL ASSIGNMENT OF HEXAMETHYLENETETRAMINE–h_{12} AND –d_{12}. Bertie, J.E.; Solinas, M. (Department of Chemistry, University of Alberta, Edmonton, Alberta, Canada). J. Chem. Phys. 61: No. 5, 1666-1677 (1 Sept 1974).

The infrared spectra of polycrystalline hexamethylenetetramine–h_{12} and –d_{12} (HMT–h_{12} and HMT–d_{12}) at 300 and 100°K, and the Raman spectra of polycrystals, single crystals, and saturated aqueous solutions of HMT–h_{12} and HMT–d_{12} at 300°K, have been recorded. The infrared spectra and the Raman spectra of the single crystals yielded an unambiguous assignment of most of the zero wave vector fundamental vibrations in the solid. Product rule and normal coordinate calculations verified the mutual compatibility of the assignments for the two isotopic molecules, and gave a detailed description of the vibrational modes. The spectra of HMT–h_{12} and their assignment differ slightly from those of previous authors, while the spectra of HMT–d_{12} have not been reported previously. The only F_1 mode whose frequency is well established is ν_{16}, at 378 cm^{-1} in HMT–h_{12} and 315 cm^{-1} in HMT–d_{12}. The longitudinal and transverse components of several of the infrared–active F_2 modes have been unambiguously assigned in the Raman spectra. (auth)

26438 MAGNETIC RELAXATION AND QUADRUPOLE SPLITTING FOR LIQUID CRYSTALLINE SOLUTIONS OF POLY–γ–BENZYL–L–GLUTAMATE IN $CDCl_3$ AND CD_2Cl_2. Fung, B.M.; Martin, T.H. (Department of Chemistry, University of Oklahoma, Norman, Oklahoma 73069). J. Chem. Phys. 61: No. 5, 1698-1702 (1 Sept 1974).

The spin–lattice relaxation time (T_1) of protons and deuterons and the deuterium quadrupole splitting in liquid crystalline solutions of poly–γ–benzyl–L–glutamate (PBLG) in $CDCl_3$ and CD_2Cl_2 are reported. The proton T_1 of PBLG has a strong frequency dependence; as a function of temperature, it shows a minimum at high frequencies. The data cannot be conveniently handled by a rigid ellipsoid model, but calculations based upon a log–Gaussian distribution in the correlation time show reasonable agreement with experimental data. The deuterium quadrupole splittings of $CDCl_3$ and CD_2Cl_2 are linear functions of the reciprocal temperature, with slopes independent of concentration. T_1 for deuterium in the solvents does not show any anomaly in the concentration range in which the phase transition occurs. (auth)

26439 INFLUENCE OF LARGE AMPLITUDE VIBRATIONAL MOTION ON THE RATE OF INTERSYSTEM CROSSING: A STUDY OF SINGLE VIBRONIC LEVEL FLUORESCENCE FROM ANILINE–h_7, ANILINE N, N–d_2, ANILINE–d_5, AND ANILINE–d_7. Scheps, R.; Florida, D.; Rice, S.A. (Department of Chemistry and The James Franck Institute, University of Chicago, Chicago, Illinois 60637). J. Chem. Phys. 61: No. 5, 1730-1747 (1 Sept 1974).

Results of single vibronic level fluorescence measurements in aniline–h_7, aniline–N, N–d_2, aniline–d_5, and aniline–d_7 are reported. For each excited level the radiative and nonradiative lifetimes and fluorescence yields have been obtained. The dependence of the nonradiative lifetime of the excited level on the excess energy in aniline–h_7 is seen to behave similarly to that in benzene for states independent of inversion mode excitation. Levels involving inversion amplitude must be treated separately; we interpret their lifetimes by postulating that a nonplanar triplet state is involved in the intersystem crossing. Deuteration in the ring and amino positions affects the nonradiative lifetimes to different degrees and leads to the rejection of crossing to the $^3B_2$ state as the rate determining step. A detailed study of the dependence of the nonradiative process on excitation of the inversion mode was carried out using the methods of Heller, Freed, and Gelbart. The numerical calculations were based on Franck–Condon overlap factors appropriate for transitions from a near planar initial state to a significantly bent final state. The experimental trends observed with excitation of inversion mode were qualitatively reproduced for all the molecules studied except aniline N, N–d_2. (auth)

26440 POSITION–DEPENDENT ISOTOPE EFFECTS IN $T_1(\pi\pi^*) \rightarrow S_0$ RADIATIONLESS TRANSITIONS OF AROMATIC MOLECULES WITH NONBONDING ELECTRONS. Kanamaru, N.; Lim, E.C. (Department of Chemistry, Wayne State University, Detroit, Michigan 48202). J. Chem. Phys. 61: No. 4, 1582-1584 (15 Aug 1974).

Rate constants for radiationless transitions of various isomers of dibenzo [f, h] quinoxaline and quinoxaline are determined from quantum yields and lifetimes of luminescence. It is found that the importance of nonequivalent (C–H) groups is vastly different for aromatic molecules with nonbonding electrons, and this leads to a deuterium isotope effect which is extremely position dependent. (AIP)

26441 RAMAN AND INFRARED ABSORPTION SPECTRA OF CERTAIN COMPLEXES OF MOLECULAR NITROGEN WITH COMPOUNDS OF THE TRANSITION METALS. Kachapina, L. M.; Borod'ko, Yu. G.; Sazhnikova, A. V.; Zakharova, I. A.; Butenkova, T. V.; Lenenko, V. S. (Inst. of Chemical Physics, Moscow). J. Struct. Chem. (USSR) (Engl. Transl.); 15: No. 1, 32-36(1974).

Translated from Zh. Strukt. Khim.; 15: No. 1, 37-41(1974).

A comparative study of the infrared and Raman spectra of mononuclear and binuclear complexes of molecular nitrogen with compounds of transition metals is presented. Spectra of deuterated and normal complexes are tabulated. The integrated intensities of the ν(NN) vibration are measured for a number of mono- and binuclear complexes. On passing from mononuclear to binuclear complexes the integrated intensities of the ν(NN) vibration in the infrared spectrum diminish, while in the Raman spectrum they increase. In binuclear complexes there is a wider range of values of the frequencies and intensities of the ν(NN) vibration in the infrared and Raman spectra than in the mononuclear complexes. Some special characteristics of the ν(NN) vibration in the spectra of crystalline samples are indicated. (auth)

26442 STRUCTURE, DIPOLE MOMENT, AND QUADRUPOLE BONDING CONSTANTS OF PYRAZOLE. Nasibullin, R. S.; Latypova, R. G.; Troitskaya, V. S.; Vinokurov, V. G.; Pozdeev, N. M. (Inst. of Chemistry, Ufa, USSR). J. Struct. Chem. (USSR) (Engl. Transl.); 15: No. 1, 41-44(1974).

Translated from Zh. Strukt. Khim.; 15: No. 1, 47-50(1974).

Results of an investigation of the microwave spectra of 12 pyrazole molecules with different isotopic compositions are presented. The r_s coordinates of the hydrogen and nitrogen atoms were determined. Data were compared on deuterium and ^{15}N-containing pyrazoles. The approximate r_0 structure of the molecules is given: N_1-N_2 1.351, N_2-C_3 1.325, C_3-C_4 1.422, C_4-C_5 1.387, C_5-N_1 1.354, N_1-H 1.002, C_3-H_3 1.083, C_4-H_4 1.073, C_5-H_5 1.081 Å, $\angle N_1N_2C_3$ 104.2°, $\angle N_2C_3C_4$ 112.3°, $\angle C_3C_4C_5$ 103.7°, $\angle C_4C_5N_1$ 106.6°, $\angle C_2N_2N_1$ 113.1°, $\angle H_1N_1N_2$ 119.6°, $\angle N_2C_3H_3$ 119.9°, $\angle C_3C_4H_4$ 128.5°, $\angle H_5C_5N_1$ 122.0°. The quadrupole interaction constants of the ^{14}N nuclei, the dipole-moment components, and the total molecular dipole moment (μ = 2.20) are considered. (auth)

26443 INVESTIGATION OF THE CONFORMATIONAL TRANSITION IN CRYSTALLINE N-ACETYL-L-PROLINE METHYLAMIDE BY IR SPECTROSCOPY IN THE CENTRAL AND FAR REGIONS. Tul'chinskii, V. M.; Kogan, G. A.; Tsetlin, V. I. (Inst. of Chemistry of Natural Compounds, Moscow). J. Struct. Chem. (USSR) (Engl. Transl.); 15: No. 1, 138-140(1974).

Translated from Zh. Strukt. Khim.; 15: No. 1, 151-154(1974).

A schematic representation of the molecular structure of N-acetyl-L-proline methylamide (I) in the crystalline state is given, and its ir spectrum in the 4000-40 cm^{-1} is shown. The high value for the frequency $\nu_{C=O}$ = 1670 cm^{-1} indicate that there is a C = O group which is not hydrogen-bonded in the molecule in accordance with the x-ray diffraction data. The assignment of the vibrations of amides IV-VI in the low-frequency region of the spectrum was carried out on the basis of an analysis of the ir spectra of pyrrolidine, acetylpyrrolidine, and N-deuterosubstituted I. At this time the assignment of the band at 788 cm^{-1} to the vibration of amide V (γND = 554 cm^{-1}) was based on the ratio $\gamma NH/\gamma ND \simeq 1.4$ for short peptides, whereas the band at 740 cm^{-1}, which also shifts considerably when I is N-deuterated to the 649 cm^{-1} region, is probably not attributable to amide V. (auth)

26444 INFRARED SPECTRA OF 4-SUBSTITUTED QUINOLINE-2-CARBOXYAMIDES. Dziembowska, T.; Szafran, M. (Univ., Poznan, Poland). Rocz. Chem.; 48: No. 6, 1001-1012 (1974).

Infrared spectra of 4-R-quinaldamines (R = H, Me, Cl, OMe) and 2-naphthamide, their partially and fully N-deuterated analogues have been obtained in solid state and solution, and assignments for carboxyamide frequencies have been proposed. (auth)

26445 ANAEROBIC CHEMILUMINESCENT REACTION OF ARYL GRIGNARD REAGENTS WITH ARYL PEROXIDES. Bolton, P. H.; Kearns, D. R. (Univ. of California, Riverside). J. Phys. Chem.; 78: No. 19, 1896-1899(12 Sep 1974).

A new anaerobic chemiluminescent reaction is reported: the reaction of aryl Grignard reagents with benzoyl peroxide or tert-butyl peroxybenzoate. This reaction of the aryl Grignard reagents with the aryl peroxides exhibits a bright red chemiluminescence. The emitting species for this reaction has been identified as the triphenylmethyl radical. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 26522.

26446 ISOTOPIC EXCHANGE KINETICS OF THE PHOSPHATE IONS BETWEEN AQUEOUS SOLUTION AND SOLID ZIRCONIUM PHOSPHATE. Rahman, M. K.; Barrett, J. (Chelsea Coll. of Science and Tech., London). J. Inorg. Nucl. Chem.; 36: No. 8, 1899-1901(Aug 1974).

A comprehensive study of the mechanism of isotopic exchange of the labelled phosphate ions in solution with the phosphate ion in solid zirconium phosphate was reported in Barrett et al. (Bull. Soc. Chim. Fr. Special Issue P, 1833 (1968)) and Rahman et al., (J. Chromat.; 69: 261 (1972)). The kinetic data could not be satisfactorily explained in terms of a single rate controlling process. The Boyd equation (Boyd et al., J. Am. Chem. Soc.; 69: 2036 (1947)) and the Reichenberg test (Reichenberg, J. Am. Chem. Soc.; 75: 589 (1953)), while applied without any presumption to the experimental data published in Rahman et al. (above), could not explicitly prove or disprove that the exchange reaction was controlled by particle diffusion. Some limitations of the Boyd equation and the Reichenberg test are discussed in the present paper. (UK)

26447 KINETIC STUDY OF ISOTOPIC EXCHANGE OF TERBIUM IONS WITH TERBIUM-ETHYLENEDIAMINETETRAACETATE IN AQUEOUS AND MIXED SOLVENTS. Neelakantan, K. Toronto; Univ. of Toronto (1973). vp. National Library of Canada, Ottawa.

Thesis (Ph. D.).

The kinetics of self-exchange of Tb(III) ion with its ethylenediaminetetraacetate (EDTA) chelate was investigated in aqueous solutions and in mixed solvents consisting of acetone-water, and 1-propanol-water; terbium-160 was used as radiotracer. (LK)

26448 ACID-CATALYZED HYDROGEN EXCHANGE OF ACETOPHENONES. Evidence for the Inapplicability of the Reactivity-Selectivity Principle. Gilbert, T. J.; Johnson, C. D. (Univ. of East Anglia, Norwich, Eng.). J. Amer. Chem. Soc.; 96: No. 18, 5846-5854(4 Sep 1974).

The dependence of rate on acidity for the 3- and 5-hydrogen exchange of some 4-substituted acetophenones in aqueous deuteriosulfuric acid has been determined. Reaction is shown to occur on the keto free base form, the enol form being in such small concentration that if it were sufficiently reactive to undergo observable exchange it would direct the reaction into the 2 and 6 positions. Treatment of the data in terms of standard acidity function theory demonstrates apparent lack of dependence of transition state structure on the rate of hydrogen exchange in aromatic substrates, in contradiction of the widely accepted reactivity-selectivity principle, and thus by implication the Hammond postulate. Related data bearing on the thermodynamic acidity function theory are also discussed. (auth)

Feed Materials Processing

Refer also to abstracts 27094 and 27237.

26449 (CONF-730907-P2, pp 945-949) DISTRIBUTION OF AIRBORNE ACTIVITY IN A URANIUM MILL USING COBWEBS. Jha, G.; Eappen, K. P. (Bhabha Atomic Research Centre, Bombay). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Cobwebs found in the different sections of the uranium mill at Jaduguda were observed to trap dust particles in the respirable size range (about 60% respirable). As such these were taken to represent the dust particles inhaled by the workers. The dust collected from the cobwebs were analyzed for U(nat), ionium (^{230}Th), radium (^{226}Ra), and polonium (^{210}Po). The results indicate that equilibrium in the airborne activity exists only in the initial stages of operations, viz during crushing and screening. In other sections of the mill the equilibrium is found to be disturbed to different degrees. (auth)

26450 (KFK-1849, pp 108-227) EXPLORATION OF ORE DEPOSIT. Apr 1974. (In German).

With figs., tabs. and refs.

In annual report 1973.

Use of actinides (particularly ^{252}Cf) in the exploration of ore deposits is reviewed. Special neutron-borehole probes are used in the analysis of underground deposits as well as in the in-situ analysis of deep-sea sediments. Some technical details and also cost evaluations are reported. A measuring method by means of an x-ray fluorescence borehole probe is described. Special emphasis is placed on the development of a trailing equipment system for the exploration of manganese modules. Another objective of the project concerns the utilization of an on-line activation procedure by means of a ^{252}Cf-neutron source. For this purpose, a loop for continuous irradiation of product fluxes has been built. The evaluation of the analysis spectra requires the development of special computer programs. (GE)

26451 LEACHING OF INDIVIDUAL HALF-INCH LUMPS OF URANIUM ORE FROM AGNEW LAKE, ONTARIO. Manchee, R. J. (Microbiological Research Establishment, Salisbury, Eng.); Garrett, K. H. Inst. Mining Met., Trans., Sect. C; 83: C115-C117 (1974).

Under the leaching conditions used, lumps with a high initial content of uranium released it more readily than lumps with a low initial content. Reasons for this are discussed. High yields of uranium are obtainable from a sample of ore consisting of lumps much larger than the small particles processed in a conventional plant. Increased leaching time is necessary, however, and it remains to be seen whether this is economically acceptable. It is considered that the results support a case for further investigations into the problem, in view of its possible application to in situ underground leaching. It is stated that, if successful, ore crushing plant would be unnecessary, thus saving capital and processing costs and eliminating noise and waste ore dumps. (UK)

26452 PRESSURE HYDROMETALLURGY: A REVIEW. Derry, R. (Warren Spring Lab., Herts, Eng.). Miner. Sci. Eng.; 4: No. 1, 3-24(Jan 1972).

The thermodynamic, kinetic, and solubility factors relevant to reactions in hydrometallurgical systems at elevated temperatures and pressures are discussed. The commercial applications to date of pressure hydrometallurgical systems for the recovery of metal values from ores, concentrates, and secondary materials are given, and the considerable volume of research into pressure hydrometallurgical processes, which have not yet been operated commercially, is reviewed metal by metal, including Al, W, Mo, U, Ni, Co, Cu, and Zn. (auth)

26453 CONCEPTUAL DESIGN FOR THE LEACHING OF SULFIDIC URANIUM ORES WITHOUT REAGENTS. Dasher, J. (Bechtel Corp., San Francisco). Miner. Sci. Eng.; 4: No. 4, 28-35(Oct 1972).

Sulfidic uranium ores, which account for most of the proved uranium reserves of the free World, have been leached with sulfuric acid and an oxidant in about 30 plants. They can also be leached much more quickly under pressure without reagents other than the air needed for agitation. A conceptual design of such a leaching facility with some novel features was devised. Heat, power, and space requirements are reduced. Savings substantial enough to justify development of the reagentless leach are indicated. (auth)

26454 FERRIC ION AS A LEACHING MEDIUM. Dutrizac, J. E.; MacDonald, R. J. C. (Dept. of Energy, Mines, and Resources, Ottawa). Miner. Sci. Eng.; 6: No. 2, 59-100(Apr 1974).

The leaching of base metal sulfides and of uranium oxides by acidic ferric ion media is reviewed. A description is also given of the preparation, regeneration, and properties of such leaching media. From the discussion of the kinetics of reaction of various minerals with ferric ion, it emerges that, for many minerals, the reaction rates are sufficiently rapid to be of commercial interest for recovering the sought-after metal. A brief discussion of actual and proposed commercial processes using ferric ion leaching is also given. (auth)

Radiation Chemistry

Refer also to abstracts 26484, 26486, 26488, 27022, 27538, 27561, 28582, and 28750.

26455 (AD-773588) STUDIES OF RADIATION PRODUCTS IN MATTER. Final Report, 1 October 1970-2 November 1973. Gordy, W. (Duke Univ., Durham, N. C. (USA). Dept. of Physics). 1 Feb 1974. 7p. (AROD-9491-11-P). NTIS $3.00.

A list of publications and papers for a three-year research project concerning the effects of various types of radiation on various compounds, especially properties such as molecular structure and free radical production is presented. (GRA)

26456 (CEA-CONF-2649) DEVELOPMENT AND STUDY OF THIN POROUS MEDIA USABLE AS MEMBRANES. Marchand, J.; Puig, J. R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Centre d'Application et de Promotion des Rayonnements Ionisants). Dec 1973. 18p. (In French). (CONF-731219-1). Dep. NTIS (US Sales Only) $4.00.

From colloquium on separation techniques with the aid of macromolecular materials; Nancy, France (9 Dec 1973).

Different types of heavy ionizing particles and polymer films were tested in order to form porous membranes. The irradiation of the polyester and PVC films by fission fragments from ^{252}Cf was used. The number of pores obtained can reach $10^8/cm^2$. The direct grafting under ^{252}Cf of vinyl-2-pyridine on polyester gave positive results. Water flows, stabilized at 240 l day^{-1} m^{-2} under 0.2 bar, after a period of rapid deformation of the film, were obtained across porous polyester membranes (10^8 pores/cm^2, 600 Å). The study is oriented toward the use of collimated monoenergetic ions such as As^{2+} and Xe^{3+} and toward obtaining a controlled porosity on very thin thicknesses of polymers. (tr-auth)

26457 (TID-26623) INDEX AND CUMULATIVE LIST OF PAPERS ON RADIATION CHEMISTRY. Volume V, Numbers 27-52, July-December 1972. (Notre Dame Univ., Ind. (USA). Radiation Lab.). Jan 1973. 333p. Dep. NTIS $19.75.

This publication consists of an index to and cumulation of entries in the Weekly List of Papers on Radiation Chemistry, Vol V, Nos. 27 to 52. The references are grouped into the following broad categories: radiation chemistry, polymers, biological systems, hot atom chemistry, ESR, luminescence, photochemistry, theoretical, and miscellaneous. Author and keyword indexes are included. (JGB)

26458 RADIATION CHEMISTRY OF POLYSTYRENE AND STYRENE-BUTADIENE COPOLYMER. Chau, F. T. C. Waterloo, Ont.; Univ. of Waterloo (1973). vp. National Library of Canada, Ottawa.

Thesis (Ph. D.)

Aqueous polystyrene emulsions were subject to gamma irradiation at 30°C and at 0.6 Mrad/hour dose rate. The results of the (extrapolated) infinite dose gel content and gel permeation analysis of the polymer in the pre-gel region indicate that the extent of chain scission was negligible. The G(cross-link) value obtained from the dose for incipient gelation and molecular weight variations in the pre-gel region is about 0.051. Purified, gel free butadiene-styrene copolymers were prepared by emulsion polymerization with butadiene contents of 80, 55 and 30 weight percent. Radiation behavior of these materials at 30°C was independent of dose rate in the range 0.04-0.46 Mrad/hour. The scission-cross-linking ratio was about 0.40 for all copolymers and was independent of total dose. Extrapolated sol fractions at infinite dose, intrinsic viscosities of irradiated polymers and $\overline{M}_n$ in the pre-gel region gave mutually consistent estimates of this ratio. The G(cross-links) value obtained from the limiting slope method is about 3.4 for all copolymers. (LK)

26459 CHEMICAL EFFECTS OF RADIATION ON POLYMERS. O'Donnell, J. H. (Univ. of Queensland, St Lucia, Australia). Proc. Roy. Aust. Chem. Inst.; 41: No. 3, 68-72(Mar 1974).

The importance of radiation effects on polymers is considered. Three reasons are advanced for its study: (1) resistance to radiation environment, (2) improvement of properties, and (3) fundamental chemistry. Aspects of irradiated polymers which are discussed include molecular size and shape, scission and cross-linking, molecular weight distribution, viscosity, gel permeation, chromatography, post irradiation, crystallinity, branching and irradiation in solution. Brief mention is made of the influence of additives on the effect of irradiation of polymers. (AT)

26460 PROTON BEAM IRRADIATION OF MATRIX SAMPLES: A NEW TECHNIQUE FOR THE STUDY OF INFRARED SPECTRA OF POSITIVE IONS. Andrews, L.; Allen, R.O.; Grzybowski, J.M. (Department of Chemistry, University of Virginia, Charlottesville, Virginia 22901). J. Chem. Phys. 61: No. 5, 2156-2157 (1 Sept 1974).

Proton irradiation of a gaseous sample produces molecular ions. The matrix isolation technique can be used to preserve these radiolysis products for spectroscopic investigation. (AIP)

26461 FURTHER STUDIES ON THE SOLID-STATE CHEMISTRY OF IRRADIATED CHOLINE CHLORIDE. Nath, A.; Agarwal, R.; Lemmon, R.M. (Laboratory of Chemical Biodynamics, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). J. Chem. Phys. 61: No. 4, 1542-1547 (15 Aug 1974).

The remarkable radiation sensitivity of crystalline choline chloride has been investigated by studies of infrared and ESR spectra, photochemical transformation of radicals, microwave electrodeless conductivity, and exposure to hydrogen atoms, vacuum ultraviolet, and thermal electrons. These studies lend support to the involvement of both ethanol radicals and electrons in the chain decomposition. They also show that hydrogen atoms can induce the decomposition. These observations indicate that during subsequent thermal treatment of γ-irradiated choline chloride, the detrapped electrons interact with ethanol radicals to form hydrogen atoms, which propagate the chain decomposition. (auth)

26462 RADICAL PAIR FORMATION IN n-DECANE AND n-DECANE-d_{22} SINGLE CRYSTALS BY γ IRRADIATION. EVIDENCE BY ELECTRON SPIN RESONANCE FOR PAIRWISE

TRAPPING AT SIX DIFFERENT DISTANCES. Gillbro, T.; Lund, A. (The Swedish Research Council's Laboratory, Studsvik, S–611 01 Nyköping, Sweden). J. Chem. Phys. 61: No. 4, 1469-1474 (15 Aug 1974).

Radicals and radical pairs in γ–irradiated single crystals of n–decane, n–decane–d_{22}, and n–octane–d_{22} have been studied by means of electron spin resonance. A simple device was constructed to permit orientation of single crystals in the magnetic field at subambient temperature. In n–decane two different radical species, $CH_2CH(CH_2)_7CH_3$, R(I), and $-CH_2\dot{C}HCH_2-$, R(II), are produced. The hyperfine coupling tensor for the α proton of the R(I) radical has the principal elements $A_{xx}=11.7$ G, $A_{yy}=35.2$ G, and $A_{zz}=19.6$ G. In n–decane–d_{22} only one species of radical, $-CD_2\dot{C}DCD_2-$, $R_D(II)$, is formed. The radical pairs in n–decane and n–decane–d_{22} consist of two R(II) or $R_D(II)$ radicals. In n–decane–d_{22}, six different radical pairs, differing in their fine–structure splitting, are observed, and of the total amount of radicals about 3% are paired at 77 K. Each radical pair is characterized by a certain temperature above which it is unstable. A short distance between the radicals constituting the pair implies a low degree of thermal stability. The radical pairs are believed to disappear by recombining to form dimers. The mechanism of radical pair formation is discussed. (auth)

26463 ESR AND INDO STUDY OF RADICALS PRODUCED IN IRRADIATED SINGLE CRYSTALS OF HISTIDINE HYDROCHLORIDE MONOHYDRATE AT LOW TEMPERATURE. Westhof, E.; Flossmann, W.; Mueller, A. (Univ., Regensburg, Ger.). Mol. Phys.; 28: No. 1, 151-160(Jul 1974).

Radicals produced in x-irradiated single crystals of histidine hydrochloride monohydrate in the temperature range 77 to 300°K were investigated using ESR spectroscopy at 9.5 and 35 GHz. The main species trapped at 77°K are the radical anions located at the carboxyl group. These are converted to deamination radicals on warming to 180°K. Conversion of the anion into the deamination radical is not found if the former is bleached with ultraviolet illumination at 77°K. At room temperature radicals formed by hydrogen addition at the imidazole ring are found after irradiation both at 77 and 300°K. These were identified previously. The identifications are supported by MO-SCF calculations at the INDO level. They show that the trapped anion species is represented by the structure $RCH(NH_2)\dot{C}OOH^-$ rather than $RCH(NH_2^+)\dot{C}OOH^-$ and the deamination radical by $R'\dot{C}H_2CHCOOH$. The anion radical is characterized by principal values of hyperfine splittings of (20.1, 24.5, 23.0) G for the proton at the neighboring C atom and (23.2, 15.6, 11.9) G for the the proton of the OH group. In the deamination radical the corresponding values are (−8.5, −18.0, −32.5) G for the α proton; 42.6 G and 7.3 G for the isotropic splittings of the two β protons. (auth)

26464 RADIOLYSIS OF 1,4-BUTANEDITHIOL. Chirakadze, G. G.; Mosashvili, G. A.; Nanobashvili, E. M. (Inst. of Inorganic Chemistry and Electrochemistry, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 75: No. 2, 353-356(Aug 1974). (In Russian).

The γ radiolysis of 1,4-butanedithiol under different physicochemical conditions was investigated. The influence of the concentration of solutions (0.01 to 8 M) on the nature of the formed products of radiolysis (1,2-dithiane and sulfur-containing polymer) was established. (auth)

26465 OXIDATION AND OPTICAL INACTIVATION OF AROMATIC L-AMINO ACIDS BY ^{60}Co GAMMA RADIATION IN AQUEOUS SOLUTION. Ehrl, A. pp 174-178 of Seventeenth International Conference on Spectroscopy. Vol. III. Milan; Associazione Italiana di Metallurgia (1973). (In German)

From 17th colloquium spectroscopicum internationale conference; Florence, Italy (16 Sep 1973). See CONF-730914-P3.

L-phenylalanine, L-tyrosine, and L-dopa in aqueous solutions at concentrations of 10^{-3}, 10^{-2}, and 10^{-1} M were irradiated at 25°C with a ^{60}Co γ source with dose rate of 40 rad/sec at doses from 20 krad to 100 Mrad. The irradiation products were separated and identified and the radiation chemical yields of racemate, tyrosine, dopachinon, and dopa were evaluated. These yields were compared with those from biochemical reactions. Both types of transformations yielded the same products, and both proceeded by a selective substitution of the hydrogen with hydroxyl groups in the 4 or 3 and 4 ring positions. (JSR)

26466 ELECTRON SPIN RESONANCE STUDY OF γ-RAY-INDUCED REACTIONS OF BROMOBENZENE AND PARA-BROMOPHENOL. Bromine Atom-Aromatic Complexes. Edwards, J.; Hills, D. J.; Mishra, S. P.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., Chem. Commun.; No. 14, 556-557 (17 Jul 1974).

Radicals exhibiting a large hyperfine interaction with bromine, obtained from solutions of the title compounds by γ-irradiation at 77°K, are identified as cyclohexadienyl radicals with hydrogen added at the bromine site. (auth)

26467 ENDOR STUDY OF AN $HASO_4^-$ RADICAL IN THE ANTIFERROELECTRIC PHASE OF AN AMMONIUM ARSENATE CRYSTAL $NH_4H_2AsO_4$. Hydrogen Bond and Antiferroelectricity. Gaillard, J.; Gloux, P.; Lamotte, B. (CEN, Grenoble, France). Mol. Phys.; 27: No. 6, 1441-1462(Jun 1974). (In French).

An $HAsO_4^-$ radical created by gamma irradiation in a single crystal of $NH_4H_2AsO_4$ was identified by ENDOR studies at 1.5°K. In particular, the hyperfine interactions corresponding to the protons of the three O—H...O hydrogen bonds linking the radical to AsO_4^{3-} tetrahedra were determined. One of these protons is situated in the "close" position with respect to an oxygen of the radical, as indicated by the formula $HAsO_4^-$, whereas the other two protons are in the "far" positions. The isotropic parts of the "far" proton interactions are found to be negative, in agreement with a mechanism of spin polarization via a partially covalent hydrogen bond; the "far protons are found to be in lateral Slater configuration, which corresponds to the defect to the antiferroelectric ordering of protons proposed by Nagamiya (Prog. Theo. Phys. Japan; 7:275(1952)). (auth)

26468 PARAMAGNETIC RESONANCE OF IRRADIATED MANGANESE CYCLOPENTADIENYLTRICARBONITRILE. Yablokov, Yu. V.; Mosina, L. V.; Kolobova, N. E. (Kazan Physical–Technical Inst.). J. Struct. Chem. (USSR) (Engl. Transl.); 15: No. 1, 126-128(1974).

Translated from Zh. Strukt. Khim.; 15: No. 1, 141-143(1974).

Results of an ESR study of fine-crystalline $CpMn(CO)_3$ (Cp = cyclopentadienyl) irradiated with x rays (source voltage 50 kV, exposure 15 h) at room temperature are presented. The ESR measurements were made on a standard JEOL-3BS-X spectrometer at a frequency of ~9160 MHz at 300 and 77°K. The results showed that paramagnetic centers developed in the diamagnetic $CpMn(CO)_3$ under the influence of irradiation, their concentration being perfectly adequate for investigation. The centers under consideration developed some eight hours after irradiation had ceased; they did not undergo any further transformations. Irradiation with ~10 MeV electrons gave analogous results. (auth)

26469 MOLECULAR WEIGHT CHANGES AND KINETICS OF THE THERMAL DESTRUCTION OF STYRENE AND α-METHYLSTYRENE COPOLYMER EXPOSED TO IONIZING RADIATION. Muinov, T. M.; Mavlyanov, A. M.; Kapkaeva, S. Kh. (Physical-Technical Inst., Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR; 17: No. 4, 21-24(1974). (In Russian).

Thermal destruction of initial and gamma-irradiated (in air) samples of the subject copolymer was studied. Decomposition occurred in two stages with activation energies of 32 kcal/mole and 55 kcal/mole, respectively. The low value of this energy at the early stage of the decomposition is due to rupture of the "weak bonds", statistically located in the macromolecules of the copolymer. The duration of the initial stage, with the low activation energy, increased with increase in the radiation dose. Changes in the molecular weight during the thermal destruction of the irradiated and nonirradiated samples were determined by a viscosimetric method. A sharp decrease in the molecular weight at the beginning of the decomposition is apparently related to rupture of the "weak" bonds. (tr-auth)

26470 ELECTRON-INDUCED NITRATION OF DPPH BY NO_2 RADICALS. Kalus, W. H. (Bundesforschungsanstalt Fuer Lebensmittelfrischhaltung, Karlsruhe (F. R. Germany). Inst. Fuer Strahlentechnologie). Z. Naturforsch., b.; 29: No. 3/4, 286-287 (Apr 1974).

2 tabs.; 4 refs.

The effect of solvents on the G values of radiolytic products formed by e^- radiolysis of DPPH (5×10^{-2} mole/l), e^- radiolysis of DPPH in nitrobenzene solution, and the concentration dependence of NO_2-$DPPH_2$ and $DPPH_2$ on the radiation dose are described. (GE)

26471 STRUCTURAL CHANGES IN HYDROGEN-CONTAINING POLYFLUORETHYLENES DUE TO GAMMA IRRADIATION. Gal'perin, E. L. Vysokomol. Soedin., Ser. A; 16: No. 6, 1265-1273(Jun 1974). (In Russian).

Structural changes in polyethylene, poly(vinyl fluoride), polytrifluoroethylene, vinylidene fluoride–tetrafluoroethylene and tetrafluoroethylene–ethylene copolymers due to 1500 Mrads of gamma irradiation (^{60}Co) were studied by large- and small-angle x-ray diffraction. The radiation resistance of the crystal and submolecular structure decreased with increase of the fluorine content of the polymer. In all polymers studied except polyvinyl fluoride there was a radiation-induced phase transition related to an increase in chain defects and leading to an increase in the symmetry of the elementary cell. Change in development of block forms and powders of hydrogen-containing polyfluoroethylenes due to radiation decreased with increase in the fluorine con-

tent. Along with a definite regularity of a change in structure of the polyfluoroethylenes due to irradiation, for polyvinyl fluoride there were some special features, which are explained. (tr-auth)

26472 LUMINESCENCE OF γ-IRRADIATED POLYETHYLENE THERMOLUMINESCENCE AND THE MULTIPLE TRANSITION BEHAVIOR OF POLYETHYLENE. Yang, W. H.; Ch'en, Y. L.; Lai, K. S.; Ch'ien, P. K. (Kirin Inst. of Applied Chemistry, Peking). K'o Hsueh T'ung Pao; 19: No. 5, 229-232(15 May 1974).

From a series of excited luminescence, γ-irradiation and thermoluminescence spectrum distribution experiments on γ-irradiated polyethylene, the authors discuss the mechanism of γ-irradiated polyethylene thermoluminescence, and how trapped electrons and luminescent centers are related to high polymeric structures and their respective chain segment movement. With regard to the multiple transition behavior of polyethylene, it is concluded that with the excitation of trapped electrons to luminescence, the luminescence peak of polyethylene at −100 to 120°C coincide with the chain segment movement of polyethylene with more than 16 carbon atoms, and that the activated energy of the main and side chain movement is slightly lower than that of the chain segment movement. (JPRS)

26473 ELECTRON SPIN RESONANCE SPECTRUM FOR A RADICAL IN γ-IRRADIATED N-IODOSUCCINIMIDE. Neilson, G. W.; Symons, M. C. R. (Univ. of Leicester, Eng.). Mol. Phys.; 27: No. 6, 1613-1617(Jun 1974).

A radical exhibiting a very large hyperfine coupling to ^{127}I, together with a small coupling to ^{14}N, formed in γ-irradiated N-iodosuccinimide at 77 K is identified as a σ^* radical anion in which the added electron is accommodated primarily in the N-I antibonding σ-orbital. (auth)

26474 POLYTETRAFLUOROETHYLENE CHEMICAL DOSIMETER. Pasal'skii, B. K.; Vonsyatskii, V. A.; Lavrentovich, Ya. I.; Kabakchi, A. M. Sov. At. Energy (Engl. Transl.); 35: No. 6, 1126-1128(Dec 1973).

Translated from At. Energ. (USSR); 35: No. 6, 427-428(Dec 1973).

In order to expand the possibilities for using PTFE in chemical dosimetry, the influence of parameters, of the type of radiation acting on the PTFE, and of the various other factors on the character and degree of radical formation in this polymer were investigated. PTFE films (40, 100, and 200 μ thick) were irradiated with ^{60}Co gamma radiation 0.23-and 1-MeV electrons, 5-7-MeV protons, 13-MeV deuterons, and 23-MeV α-particles. (LK)

26475 RADIOTHERMOLUMINESCENCE METHOD FOR STUDYING THE EFFECT OF FILLING ON THE GLASS-TRANSITION TEMPERATURE OF NONCROSS-LINKED AND CROSS-LINKED CRYSTALLIZING POLYMER. Solomko, V. P.; Boyarskii, G. Ya.; Nizhnik, V. V.; Shrubovich, V. O. (Kiev State Univ.). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 7, 632-634(Jul 1974). (In Ukrainian).

The effect of filling on the glass-transition temperature (T_g) of the cross-linked and noncross-linked low pressure polyethylene (LPP) was investigated. It is shown that both cross-linking and filling of the initial polymer are accompanied by a rise in its T_g. The filling of cross-linked LPP does not lead to a change in T_g of the polymer. (auth)

26476 ELECTRON SPIN RESONANCE STUDIES AND RADIATION-INDUCED DECOMPOSITION OF SUCROSE. Limon M, M. A.; Reyes L, J.; Menchaca S, H.; Hernandez G, M. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis., Supl. Fis. Apl.; 22: FA69-FA80(1973).

The growth dose behavior of the electron- and gamma-induced ESR signal in polycrystalline sucrose was determined for a wide range. The intensity of the ESR signal was nearly constant for room temperature stored samples irradiated at low dose, and decreased during the first days for samples irradiated at high dose. The stability of the induced radicals was caused by the network of hydrogen bonds. The intensity decreased when the samples are heated and the ESR signal disappears at temperatures near the melting point. (auth)

26477 SUBMICROSECOND FORMATION AND OBSERVATION OF REACTIVE CARBANIONS. Bockrath, B.; Dorfman, L. M. (Ohio State Univ., Columbus). J. Amer. Chem. Soc.; 96: No. 18, 5708-5715(4 Sep 1974).

The benzyl carbanion has been formed and studied in submicrosecond times by electron attachment to dibenzylmercury in tetrahydrofuran solution using the pulse radiolysis method. This carbanion has been studied in its sodium ion paired state, $C_6H_5CH_2^-Na^+$, and in its free state, $C_6H_5CH_2^-$, in the absence of sodium ion. The optical absorption spectra of both species were determined. The spectrum of the former is in agreement with previous observations, while that of the latter, which has heretofore not been observed, has an absorption maximum at 362 nm, with a molar extinction coefficient of 8300 M^{-1} cm^{-1} at the maximum. Absolute rate constants have been determined at 24° for the formation of both species: $C_6H_5CH_2^-$ is formed by the reaction e^-_{sol} + $(PhCH_2)_2Hg$, 2.7×10^{10} M^{-1} sec^{-1}; $C_6H_5CH_2^-Na^+$ is formed by ion pairing of the free carbanion with sodium ion, $PhCH_2^-$ + Na^+, 1.5×10^{11} M^{-1} sec^{-1}, and by reaction of the sodium paired solvated electron with dibenzylmercury, Na^+, e^-_{sol} + $(PhCH_2)_2Hg$, 7.9×10^9 M^{-1} sec^{-1}. Absolute rate constants for the proton transfer reactions of these carbanions from methanol, ethanol, ethanol-O-d, tert-butyl alcohol, and water have also been obtained. The values for $C_6H_5CH_2^-$ are: 2.3×10^8, 1.4×10^8, 1.2×10^9, 1.6×10^7, 5.3×10^7 M^{-1} sec^{-1}, respectively. The values for $C_6H_5CH_2^-Na^+$ are: 5.8×10^9, 3.7×10^9, 2.1×10^9, 1.3×10^9, and 5.5×10^9 M^{-1} sec^{-1}, respectively. The observed isotope effect is discussed. Comparison is made of the relative rate constants for proton transfer to various carbon bases. This method of generating carbanions and of observing their fast reactions is of general applicability. (auth)

26478 RADIATION-INDUCED EMULSION COPOLYMERIZATION OF TETRAFLUOROETHYLENE WITH PROPYLENE. V. Formation of Acid and Its Effect. Suzuki, N.; Matsuda, O.; Okamoto, J. (Japan Atomic Energy Research Inst., Takasaki). J. Appl. Polym. Sci.; 18: No. 8, 2457-2464(Aug 1974).

In the radiation-induced emulsion copolymerization of tetrafluoroethylene with propylene, it was found that hydrofluoric acid (HF) is formed in the course of polymerization. The amount of HF formed increased linearly with the irradiation time in all cases. The rate of HF formation was maximum at 0.3 wt-% emulsifier and increased linearly with tetrafluoroethylene content in the monomer mixture. On the other hand, the conversion and the molecular weight decreased remarkably by addition of 0.1 M HF. The particle diameter of copolymer obtained in the presence of HF was larger than that obtained in the HF-free system. On the contrary, the number of polymer particles was less than that obtained in the HF-free system. The decrease in the conversion and the molecular weight was attributed mainly to the conversion of part of ammonium perfluorooctanoate to perfluorooctanoic acid by formation of acid or addition of acid. (auth)

26479 PRESSURE DEPENDENCE OF FREE-RADICAL DECAY IN IRRADIATED POLY(VINYL ACETATE). Szocs, F.; Rostasova, O. (Inst. of Polymer, Bratislava). J. Appl. Polym. Sci.; 18: No. 8, 2529-2532(Aug 1974).

The effect of pressure on the decay of the free radicals generated by gamma irradiation in poly(vinyl acetate) was investigated. Results show that the rate constant of free-radical decay exhibits an expressive dependence on pressure and that the activation energy defined by the Arrhenius equation also shows a dependence on pressure. (LK)

26480 RADIATION-INDUCED EMULSION POLYMERIZATION OF TETRAFLUOROETHYLENE. Suwa, T.; Takehisa, M.; Machi, S. (Japan Atomic Energy Research Inst., Takasaki). J. Appl. Polym. Sci.; 18: No. 8, 2249-2259(Aug 1974).

The radiation-induced emulsion polymerization of tetrafluoroethylene was carried out with the use of ammonium perfluorooctanoate as an emulsifier at an initial pressure of ca. 30-35 kg/cm^2. The polymerization rate was shown to be proportional to about the 0.8 power of the dose rate in the range of 2×10^4 to 10^5 R/hr and to be almost independent of emulsifier concentration. The molecular weight of the polymer lies in the range of 10^4 to 10^5, increases with reaction time at the initial stage, and decreases with emulsifier concentration, but is independent of the dose rate from 2×10^4 to 6×10^4 R/hr. If the emulsifier is not used, a polymer with a molecular weight as high as 1.8×10^6 to 2×10^7 is obtained. Apparently, the emulsifier and its radiolysis products act as chain transfer agents. Postirradiation polymerization was found to take place with the formation of products with increased molecular weight. (auth)

26481 SUBMICROSECOND FORMATION AND OBSERVATION OF REACTIVE CARBONIUM IONS. Jones, R. L.; Dorfman, L. M. (Ohio State Univ., Columbus). J. Amer. Chem. Soc.; 96: No. 18, 5715-5722(4 Sep 1974).

The triphenylcarbonium ion, $(C_6H_5)_3C^+$, and the benzyl cation, $C_6H_5CH_2^+$, have been formed and studied in submicrosecond times in 1,2-dichloroethane solution at room temperature using the pulse radiolysis method. The optical absorption spectra of both species were determined. The benzyl cation, which has heretofore not been observed, has an absorption maximum at 363 nm

very similar to that of the benzyl carbanion which has recently been reported from our laboratory. Absolute rate constants for the reactions of benzyl cation with methanol, ethanol, bromide ion and iodide ion have been determined at 24°. The values are 7.4×10^7, 1.3×10^8, 5.2×10^{10} and 4.9×10^{10} M^{-1} sec^{-1}, respectively. The reactivity with benzene was too low to permit determination of a rate constant value, but a rough upper limit was estimated. This technique of generating and studying reactive carbocations in solution is of general applicability. (auth)

Radiochemistry and Nuclear Chemistry

26482 (AEC-tr-7226/12) NUKLEONIKA. Translated from Nukleonika; 17: No. 12, 621-672(1972). 55p. (TT-71-54027/12). Dep. NTIS $5.75.

Hot-Atom Chemistry

26483 (COO-1713-49) REACTION STUDIES OF HOT SILICON AND GERMANIUM RADICALS. Progress Report, September 1, 1973–August 31, 1974. Gaspar, P. P. (Washington Univ., St. Louis, Mo. (USA). Dept. of Chemistry). 31 Aug 1974. Contract AT(11-1)-1713. 43p. Dep. NTIS $5.25.

In the last year progress has been made in the following major areas: (1) primary reactions of recoiling silicon atoms and the reactions of silylene; (2) the role of ionic reactions in the chemistry of recoiling silicon atoms; (3) study of silyl radical reactions by electron spin resonance spectroscopy; and (4) production of macroscopic quantities of thermal atoms for reaction studies. (auth)

26484 GAMMA RADIATION EFFECTS ON THE VALENCE DISTRIBUTION OF ^{32}P AND ^{35}S IN PURE AND OH^- DOPED KCl SINGLE CRYSTALS. Baptista, J. L.; Marques, N. S. S. (Junta de Energia Nuclear, Sacavem, Portugal). J. Inorg. Nucl. Chem.; 36: No. 8, 1683-1685(Aug 1974).

Pure and OH^- doped samples of KCl single crystals were examined for the valence distribution of ^{32}P and ^{35}S recoils, after reactor irradiation at ambient temperature or 195°K. Post-gamma irradiations showed that the marked differences between pure and doped samples are probably a result of differences in the gamma radiolysis of the crystal matrix. Some new reactions of the ^{35}S recoil species were observed on post-gamma irradiation of OH^- doped crystals. (auth)

26485 CLASSICAL TRAJECTORY STUDY OF THE HOT ATOM GAS PHASE REACTIONS OF TRITIUM WITH METHANE, AND ISOTOPIC VARIATIONS. Valencich, T. J. Irvine, CA; Univ. of California (1974). 354p. University Microfilms Order No. 74-19,242.

Thesis (Ph. D.).

The gas phase reactions of hot tritium with methane, and four isotopic counterparts, have been simulated by classical trajectory methods. A flexible general reactive model was developed to define the potential energy hypersurface. This investigation demonstrated, for the first time, the use of inexpensive tabular functions for trajectory studies. The surface parameters used in this study were calibrated by photochemical experimental results to avoid ionic and multiple surface contributions possible with nuclear recoil experiments. The abstraction reaction was the lowest overall energy process. Inversion was the dominant substitution mechanism only at low energies. Stereochemical implications for organic SH2 reactions were noted from the behavior of inverting and retaining substitution events. The results of this work have indicated the limitations of oversimplified mechanistic conclusions drawn from hot atom experiments. The principal reactive mechanisms changed with energy. Reaction pathways with different energetic and dynamic requirements competed with one another in some energy ranges. Reaction events were sensitive to changes in the mass of the attacking particle and the carbon substituents at both high and low translational energies. Non-reactive energy losses were not energy independent. This research has shown that simplified or restricted potential representations and limited isotopic testing are inadequate sampling methods for many particle systems. (Diss. Abstr. Int., B)

26486 STUDY OF THE ^{105}Ru–RETENTION AFTER NEUTRON IRRADIATION OF RUTHENOCENE SOLUTIONS. Jacob, B. Darmstadt, Ger.; Technische Univ. (1973). 4p. (In German). INIS.

Thesis. Shortened version. Available from the library of the Technische Univ. Darmstadt.

The chemical consequences of the nuclear reaction $^{104}Ru(n,\gamma)$ ^{105}Ru in ruthenocene solution were investigated as a function of the time of irradiation, solvent, ruthenocene concentration and of the addition of ferrocene as well as its monoacetyl and diacetyl derivatives. The dependence of concentration as well as the dependence of catcher substance additions made it possible to differentiate between primary and secondary retention and between "hot" substitution reactions (scavenger-independent) and epithermal and thermal recombination reactions (concentration and scavenger-dependent). The polarity of the solvent used also had a definite influence on the retention. The possible reaction steps that lead to secondary retention are discussed. The primary retention, 1.5 to 2%, permits the conclusion that in most cases (approx. 98%), the ^{105}Ru recoil energy by far exceeds the bonding energy of Ru in ruthenocene. (GE)

26487 THE GAS-JET RECOIL TRANSPORT METHOD AS PART OF A SYSTEM FOR RAPID AQUEOUS RADIOCHEMICAL SEPARATIONS. Aumann, D. C.; Weismann, D. (Technische Univ. Muenchen, Garching (F.R. Germany). Inst. fuer Radiochemie). Nucl. Instrum. Methods; 117: No. 2, 459-465(15 May 1974).

The gas-jet recoil transport method has been adapted for the use as part of a system for rapid radiochemical separations. The recoil atoms are transported directly into a liquid chemical system with which subsequent chemical separations are carried out. Calculations show that the collector chamber can be operated at atmospheric pressure to allow easy performance of the chemistry without increasing severely the overall transport time. Transport efficiencies of 15 to 20% for fission products have been achieved. Application of the method is illustrated by radiochemical separations of Ba fission products from the fission-product mixture obtained by using a Ba carrier solution in HNO_3 as catcher. (auth)

Properties of Radioactive Materials

Refer also to abstracts 27097, 27119, 27283, 27307–27309, 27437, 27537, and 28710.

26488 (INIS-mf-1342) CARBON-14 DECAY IN ORGANIC MOLECULES: RETENTION AND STRUCTURE. Raadschelders-Buijze, C. (Vrije Universiteit, Amsterdam (Netherlands)). 8 Feb 1974. 83p. INIS.

A coherent group of ^{14}C-retention data has been obtained with a higher accuracy than in previous work. With these data the relationship between retention and molecular characteristics is investigated. Multiply labelled acetylene, propane, cyclopropane, cyclohexane, and benzene were selected for study, differing in terms of hybridization, aromaticity, and ring structure. A second ^{14}C atom in the parent molecule is necessary in order to detect extremely small amount of daughter product. After storage for a suitable period the retention products were isolated and measured. The values obtained for the acetylene retention turned out to be logically impossible, presumably because of radiolytic production of the retention compound hydrocyanic acid. The other compounds under investigation had nearly equal retentions with an average around 50%. From these data it is concluded that the retentions of ^{14}C-tagged hydrocarbons are independent of molecular characteristics within the margin of experimental errors (±2%). The result is in accordance with theoretical evidence. INDO calculations of decay-induced electronic excitation indicate that the molecular structure has hardly any influence. The theoretical electronic retentions of the investigated compounds vary from 61 to 63%. Therefore, it is likely that only the direct environment of the disintegrated atom is affected by the decay event. An estimation of the charge distribution and bond orders supports this conclusion. Bond-breaking by the recoil effect is naturally highly dependent upon the bond energies and thus upon the molecular structure but approximate calculations indicate that its influence on the retention is very limited. Several explanations of the difference between the experimental and the theoretical values are put forward. (INIS)

26489 APPLICATION OF A NONSPECIFIC TRITIATION METHOD FOR ORGANIC MOLECULES. Buchman, O.; Ori-Bar, I.; Shimoni, M.; Smoskowitz, L. (Univ. of the Negev, Beersheva, Israel). J. Label. Compounds; 10: No. 2, 345-354(1974). (In French).

A method for labelling organic molecules using gaseous tritium has been applied to the general labelling of some complex structural compounds. Experimental results are given, including the specific activities obtained. The effectiveness of the labelling by platinum black, generated in situ by tritium, was compared to the poor exchange yields obtained when the catalyst is activated by hydrogen before use. Raising the reaction temperature increases the specific activity of the tritiated compound. (auth)

26490 PHOTOCHEMISTRY OF CHLORO COMPLEXES OF URANIUM(IV) AND DIOXOURANIUM(VI). Condorelli, G.; Costanzo, L. L.; Pistara, S.; Tondello, E. (Univ., Catania, Italy). Inorg. Chim. Acta; 10: No. 2, 115-120(Aug 1974).

The photochemistry of UCl_6^{2-} and of $UO_2Cl_4^{2-}$ in acetonitrile solutions at 254 nm has been investigated under various experimental conditions. The main features of photochemical behavior of UCl_6^{2-} are as follows: (a) in non-deaerated solution the U(IV) undergoes an oxidation to $UO_2Cl_4^{2-}$, proceeding with a chain mechanism; (b) in deaerated solution the UCl_6^{2-} is also transformed to the hexavalent state ($UO_2Cl_4^{2-}$), then photoreduced to the tetravalent; (c) in the presence of dry HCl, the UCl_6^{-} compound is obtained. The photochemical process of $UO_2Cl_4^{2-}$ can be summarized with the following points: (a) in non-deaerated solution no photoreaction occurs; (b) in deaerated solution the $UO_2Cl_4^{2-}$ undergoes a reduction to chloro complex of UO^{2+} and (c) in the presence of HCl, the UCl_6^{-} is obtained. By analysis of the kinetic data, the quantum yields for all processes are calculated and the photoreaction mechanisms are proposed in agreement with experimental observations. (auth)

26491 REACTION OF HYDROGEN ASTATIDE WITH ATOMIC CHLORINE. Grover, J.R.; Iden, C.R. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). J. Chem. Phys. 61: No. 5, 2157-2159 (1 Sept 1974).

Differential cross sections and angular distributions for the reaction HAt+Cl→HCl+At are obtained using a molecular beam method. (AIP)

26492 HEAT CAPACITY, ENTROPY, AND ENTHALPY OF $^{242}PuF_3$ FROM 10 TO 350°K. Osborne, D.W.; Flotow, H.E.; Fried, S.M.; Malm, J.G. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 61: No. 4, 1463-1468 (15 Aug 1974).

Heat capacity measurements have been made on a 17.5 g sample of $^{242}PuF_3$ from 10 to 350°K. The measurements from 20 to 350°K were made by the quasiadiabatic method with discontinuous electrical heating. Temperature drifts in the region 18–58°K with no electrical heating were compared with the measured heat capacities to evaluate the radioactive self–heating rate, $(1.206\pm0.004)\times10^{-4}$ W/g Pu. Heat capacities from 10 to 20°K were obtained from this radioactive self–heating rate and observations of the temperature drifts with no electrical heating. A transition was observed between 110 and 122°K, with an associated excess entropy of 0.777 ± 0.027 J °K^{-1}·$mole^{-1}$ and an excess enthalpy of 92.2 ± 3.4 J $mole^{-1}$. Magnetic susceptibility measurements showed that PuF_3 undergoes antiferromagnetic ordering at 9.0 ± 0.5°K. At 298.15°K the heat capacity $C°_p$, entropy $S°$, enthalpy $H°-H°_0$, and Gibbs energy divided by temperature $(G°-H°_0)/T$ are, respectively, 92.64 ± 0.28 J °K^{-1}·$mole^{-1}$, 126.11 ± 0.36 J °K^{-1}·$mole^{-1}$, 18015 ± 54 J $mole^{-1}$, and -65.69 ± 0.18 J °K^{-1}·$mole^{-1}$. Evidence for radiation damage was observed after the compound was stored overnight in contact with a reservoir at 4.2°K, and the radiation damage annealed between 10 and 14°K. (auth)

26493 PURITY TEST OF IODINATED (^{125}I) INSULIN SOLUTION, IODINATED (^{125}I) IgE SOLUTION, AND IODINATED (^{131}I) PVP INJECTION. Studies on the Quality and Test Method of Radiopharmaceuticals. IV. Urakubo, G.; Nagamatsu, K.; Ikebuchi, H. (National Inst. of Hygienic Sciences, Tokyo). Radioisotopes (Tokyo); 23: No. 6, 342-346(Jun 1974). (In Japanese).

Gel filtration with thin layer made of Sephadex was applied to the purity test of three kinds of radiopharmaceuticals containing iodinated (^{125}I or ^{131}I) high molecular substances. Sephadex G-50, Superfine was used to make thin layers for iodinated (^{125}I) insulin solution and iodinated (^{131}I) polyvinylpyrrolidone injection, and Sephadex G-200, Superfine was used for iodinated (^{125}I) IgE solution, according to the molecular weights of these radiopharmaceuticals. Drops of these radiopharmaceuticals were spotted on wet thin layer plates and developed by declining technique with water for 1.5 to 5 hours. The distribution of radioactivities on these chromatograms was measured, and a sharp peak corresponding to the pure iodinated (^{125}I or ^{131}I) substance was observed in each case. So, this gel filtration procedure was regarded as a suitable method for purity test of these radiopharmaceuticals, detecting radioactivities due to possible degradation product and free iodine. (auth)

26494 PREPARATION, CHARACTERIZATION, THERMAL ANALYSIS AND CRYSTAL STRUCTURE OF BIS(TETRAPHENYLARSONIUM)URANYL BIS(PYRIDINE-2,6-DICARBOXYLATE) HEXAHYDRATE. Marangoni, G. (Consiglio Nazionale delle Ricerche, Padua); Degetto, S.; Bombieri, G.; Forsellini, E.; Graziani, R. J. Inorg. Nucl. Chem.; 36: No. 8, 1787-1794(Aug 1974).

A salt-like compound of formula $(Ph_4As)_2[UO_2(PDC)_2]\cdot6H_2O$ (H_2PDC = pyridine-2,6-dicarboxylic acid) was synthesized and characterized. The crystal structure was determined by x-ray analysis from three-dimensional counter data, and refined by least squares to R = 0.073 for 2750 reflections. The crystals are triclinic, space group $P\bar{1}$ with a = 15.12(1), b = 11.21(1), c = 9.35(1) Å, α = 101.22(2)°, β = 100.27(2)°, γ = 100.53(2)° and Z = 1. The uranium atom is eight-coordinate, the linear uranyl group being equatorially surrounded by an irregular hexagon of four oxygen atoms and two nitrogen atoms from two pyridine-2,6-dicarboxylate groups. The crystallographic results are related to ir measurements. A study of the thermal decomposition is also reported. (auth)

26495 CHEMISTRY OF URANIUM. XI. Sulphoxides as Ligands for Uranium(IV). Du Preez, J. G. H.; Gibson, M. L. (Port Elizabeth Univ., South Africa). J. Inorg. Nucl. Chem.; 36: No. 8, 1795-1801(Aug 1974).

The interactions of UCl_4, UBr_4, and $ThCl_4$ with various sulphoxide ligands were studied conductometrically and spectrophotometrically in acetone solutions. The results indicate that a large number of species exist simultaneously in equilibrium under such conditions. The influence of sulphoxide ligand on the positions of the equilibria, the coordination number of the uranium(IV) complex, the stoichiometry of the solid complex isolated and the relationship between the solid precipitated and the species present in solution, were studied. Dialkyl sulphoxide ligands with groups of different sizes and degrees of branching were used, viz. dimethyl sulphoxide (DMSO), diisobutyl sulphoxide (DIBSO), diisopropyl sulphoxide (DIPSO), and di-tertiarybutyl sulphoxide (TBSO). Solids isolated were $UX_4\cdot2TBSO$, $UCl_4\cdot2DIBSO$, $UBr_4\cdot4DIBSO$, $ThCl_4\cdot3DIBSO$, $(UCl_3\cdot6DMSO)(ClO_4)_2$ and $(UCl_3\cdot5DMSO)ClO_4$ (X = Cl and Br). These were characterized by spectroscopic and magnetic susceptibility measurements. The results indicated that solution studies cannot readily be used to interpret the structure of the solid complexes since a large number of species exist in equilibrium in most cases. (auth)

26496 NMR EVIDENCE ON THE STRUCTURE OF THE URANYL-MALATE COMPLEX. Pedrosa, J. D.; Gil, V. M. S. (Univ. of Coimbra). J. Inorg. Nucl. Chem.; 36: No. 8, 1803-1807 (Aug 1974).

Comparison of the proton coupling constants and chemical shifts for malic acid and its 1:1 dimeric complex with UO_2^{2+} at the same pH (around pH = 3) led to conclusions about the conformation of the ligand and the structure of the dimer. These results corroborate one of the various hypotheses previously put forward for such a structure, the remaining ones being unambiguously ruled out. The existence of geometric isomers is also indicated. (auth)

26497 KINETICS OF EXCHANGE OF TRIVALENT ACTINIDE IONS WITH EUROPIUM ETHYLENEDIAMINETETRAACETATE. Williams, K. R.; Choppin, G. R. (Florida State Univ., Tallahassee). J. Inorg. Nucl. Chem.; 36: No. 8, 1849-1853(Aug 1974).

Kinetics of exchange were studied for Cm(III), Bk(III), and Cf(III) with $EuEDTA^-$ in an aqueous solution of 0.10 M ionic strength with acetate buffer. As with Am(III) the exchange is a first order reaction with both acid-dependent and acid-independent rate terms. The rate constants for the dissociation follow an 1/r dependence (r = actinide ionic radius) whereas the rate constants for the association show a non-linear pattern with 1/r. It can be argued that the dependency of the dissociation constants is related to processes in which metal-ligand bonds are broken whereas the 1/r dependency of the association constants seem to be a function of the hydrated actinide ionic radius. (auth)

26498 PHOTOCHEMICAL METHOD FOR OBTAINING U(V) OXOCHLOROCOMPLEX. Traverso, O.; Portanova, R.; Carassiti, V. (Univ., Ferrara, Italy). Inorg. Nucl. Chem. Lett.; 10: No. 9, 771-775(Sep 1974).

Pyridinium oxopentachlorouranate(V) $(C_5H_5NH)_2UOCl_5$ was obtained by irradiation of 2×10^{-3}M deaerated dipyridine uranyl chloride $(UO_2(py)_2Cl_2)$ solutions in dry absolute ethanol in the 400 to 450 nm region for 10 hours. The compound was characterized by chemical analysis, absorption spectroscopy, and infrared spectroscopy. By continuing to irradiate 2×10^{-3}M deaerated $UO_2(py)_2Cl_2$ solutions for 50 hours, uranium(V) ethoxide ($U(OC_2H_5)_5$) was formed, and was identified in the same way. (UK)

26499 SYSTEM $Ba_2Sm_{0.67}U_{1-x}W_xO_6$. Schittenheim, H. J.; Kemmler-Sack, S. (Univ., Tuebingen, Ger.). Z. Anorg. Allg. Chem.; 407: No. 2, 181-192(Jul 1974). (In German).

The ordered perovskites $Ba_2Sm_{0.67}UO_6$ and $Ba_2Sm_{0.67}WO_6$ form a complete series of solid solutions with 4 formula units $Ba_2Sm_{0.67}U_{1-x}W_xO_6$ in the unit cell. By diffuse reflectance and ir-spectroscopic measurements the relations between color and constitution are shown. (auth)

26500 CHEMISTRY OF URANIUM. X. Octahedral Pentahalouranate(IV) Complexes. de Preez, J. G. H.; Edge, R. A.; Gibson, M. L.; Rohwer, H. E.; van Vuuren, C. P. J. (Univ. of Port Elizabeth, South Africa). Inorg. Chim. Acta; 10: No. 1, 27-32(Jul 1974).

Spectrophotometric and conductometric evidence for the existence of the octahedral $(UX_5 \cdot L)^-$ species (X = Cl, Br and I and L = neutral monodentate ligand) was obtained. The conditions for the formation of these and their UX_6^{2-} analogues in different non-aqueous solvents and in the presence of a variety of neutral ligands are reported. The following donor strength order was established using the data obtained: chloride ≧ TMPO, HMPA > sulfoxides (DMSO), C = O amides (DMA, CL, etc.) > Br^- > acetone, acetonitrile > iodide (TMPO = trimethylphosphine oxide, HMPA = hexamethylphosphoramide, DMSO = dimethyl sulfoxide, DMA = N,N-dimethylacetamide, CL = ε-caprolactam). The positions of nitrate and thiocyanate are also discussed. The implications of this order on the positions of the different equilibria obtained in the practical chemistry of uranium(IV) in nonaqueous solution are discussed. Conductometric evidence obtained for $ThCl_4$ suggests that eight coordinated $(ThCl_5 \cdot 3L)^-$ and $ThCl_6^{2-}$ species exist in non-aqueous solution. (auth)

26501 SEVEN-Co-ORDINATE URANYL COMPOUNDS WITH PLANAR QUINQUEDENTATE (N_3O_2) SALICYLALDIMINATO LIGANDS. McKenzie, E. D.; Paine, R. E.; Selvey, S. J. (Univ. of Sheffield, Eng.). Inorg. Chim. Acta; 10: No. 1, 41-45(Jul 1974).

The dianion of the ligand N,N'-bissalicylidene-1,5-diimino-3-azapentane acts as a planar quinque-dentate to metal species with a large covalent radius such as uranyl. The dioxouranium(VI) compounds of this and related ligands (with 5-Cl, 5-Br, 3-OMe, 3,5-diCl or 5,6-benzo substituents on the salicyl moiety) are examples of 2 + 5 co-ordination at the metal. A number of solvates were obtained and characterized by their X-ray diffraction patterns and ir spectra. One of these undergoes heterogeneous exchange reactions with consequent changes in the dimensions of the crystalline lattice. By contrast, the longer ligand systems based on the triamines 1,7-diamino-4-aza-heptane and 1,7-diamino-4-aza-4-methyl-heptane are much more reluctant to form seven-co-ordinate uranium(VI) compounds. These ligands, with trimethylenediamine chelate rings appear to be too large for ideal co-ordination to the metal. (auth)

26502 REACTIONS OF THE HIGHER OXIDATION STATES OF URANIUM AND MOLYBDENUM WITH SOME ORGANIC HETEROCYCLES. Sherrill, H. J. Baton Rouge, LA; Louisiana State Univ. (1973). 226p. University Microfilms Order No. 74-18,366.

Thesis (Ph. D.).

The purpose of this research was essentially threefold: (1) to prepare some fluoro and bromo complexes of uranium (V), obtain their absorption spectra and compare these with the semiempirically calculated $5f^1$ energy levels for the compounds, (2) to prepare some complexes of uranium(V) with biologically significant organic ligands in an attempt to use the metal in this unusual and unstable oxidation state to initiate ligand free radical formation, and (3) to prepare some complexes of molybdenum(IV, V, VI) with analogous biologically significant organic ligands in an attempt to simulate in these complexes the environmental and possibly the chemical activity of biological molybdenum. The compounds $CsUF_6$, $K_3UF_8 \cdot 2HF$, and $(Et_4N)_2UOF_5$, were prepared by new methods while $(Et_4N)_2UOBr_5$ was prepared by a known procedure. The energy levels for the electronic transitions for the two UO^{3+} compounds, as determined from their absorption spectra, were found to be in good agreement with the energy levels calculated semiempirically. Five new complexes of uranium have been prepared and characterized. A total of twelve new complexes of molybdenum(IV, V, and VI) have been prepared and characterized. (LK)

26503 $U_2O_3F_6$: ITS PREPARATION AND PROPERTIES. Wilson, P. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Inorg. Nucl. Chem.; 36: No. 8, 1783-1785(Aug 1974).

The compound $U_2O_3F_6$ was prepared by thermal decomposition of UOF_4 at 290°C. At room temperature it is a yellow solid. On heating to 380°C it decomposes into UO_2F_2 and UF_6 through a one-step process. Its ir spectrum and some of its reactions are described. (auth)

26504 INTERACTION OF THORIUM TETRACHLORIDE WITH CHLORIDES OF THE ALKALI METALS. Vokhmyakov, A. N.; Desyatnik, V. N.; Kurbatov, N. N. Sov. At. Energy (Engl. Transl.); 35: No. 6, 1122-1123(Dec 1973).

Translated from At. Energ. (USSR); 35: No. 6, 424(Nov 1973). This is a summary of paper No. 706/7294 with full copy held at TIC.

To determine the possibility of using alkali metal chlorides with thorium tetrachloride as electrolytes in the production of thorium, as well as the behavior of thorium tetrachloride in molten alkali chlorides, the binary systems MeCl–$ThCl_4$ (where Me represents Li, Na, K, Rb, and Cs) were studied. (LK)

26505 METHOD OF PREPARATION OF TRITIUM-LABELLED PROTEINS. Fromageot, P.; Hung, L. T.; Morgat, J. L. (to Commissariat a l'Energie Atomique). US Patent 3,828,102. 6 Aug 1974. Priority date 1 Oct 1971, France. 6p.

The protein to be labelled is protected by complexing with a specific bonding protein so as to form a stable and soluble complex which is subjected to halogenation followed by tritiation, the tritiated complex being then dissociated from the resultant mixture. The tritium-labelled protein and the tritium-labelled bonding protein are extracted successively and selectively. (Official Gazette)

26506 TRENDS IN THE NITROGEN–OXYGEN STRETCHING FREQUENCY OF 4-SUBSTITUTED PYRIDINE N-OXIDE CO-ORDINATION COMPOUNDS. Nathan, L. C. (Univ. of Santa Clara, CA); Ragsdale, R. O. Inorg. Chim. Acta; 10: No. 3, 177-181(Sep 1974).

Trends in the nitrogen–oxygen stretching frequency, ν_{NO}, for twenty-four series of 4-substituted pyridine N-oxide complexes were investigated and compared. The complexes fall into several general categories based on the correlation of ν_{NO} and $\Delta\nu_{NO}$ (the decrease in ν_{NO} of the ligands upon coordination) with σ_{PyO} substituent constants. The data suggest that the trends depend significantly on the effective charge of the central metal ion but that stereochemistry, steric effects, and the previously proposed π-bonding effects also contribute. (auth)

26507 COMPLEXES OF URANIUM(V) CHLORIDE WITH OXYGEN DONOR LIGANDS. Singh, M.; Singh, G.; Chand Paul, R. (Panjab Univ., Chandigarh, India). Inorg. Chim. Acta; 10: No. 3, 225-227(Sep 1974).

Stable uranium(V) chloride complexes of the type $UCl_5 \cdot B$ and $UCl_5 \cdot 2B$ (B = anthrone, benzanthrone, methyleneanthrone, benzalanthrone, benzil) and $UCl_5 \cdot 3$ dioxane were isolated from uranium(V) chloride solution in thionyl chloride. Magnetic susceptibilities at temperatures varying from 86°K to 300°K, electron spin resonance, infrared and reflectance spectra of some of the compounds have been studied to throw some light on the nature of these complexes. (auth)

26508 ADVANCES IN THE ORGANOMETALLIC CHEMISTRY OF URANIUM(IV). Cernia, E.; Mazzei, A. Inorg. Chim. Acta; 10: No. 3, 239-252(Sep 1974).

The recent research results on the organometallic chemistry of U(IV) was reviewed from two aspects. The first was to clarify their structures, the nature of the metal–carbon bond, and the possibility of the participation of the f electrons in the metal-ligand bond. The second was to investigate their use in catalytic reactions. Complexes with π ligands, with σ ligands, and with various other types of ligands were discussed. The catalytic behavior of some uranium derivates was reviewed. 70 references. (JSR)

26509 EFFECT OF CHEMICAL MODIFICATION OF WOOL ON METAL ION BINDING. Masri, M. S.; Friedman, M. (Dept. of Agriculture, Berkeley). J. Appl. Polym. Sci.; 18: No. 8, 2367-2377(Aug 1974).

The effect of specific functional group modification of wool on the binding of a number of metal ions (individually) from aqueous solutions was studied. The metal ion uptake profiles for the different modified keratin polymers show that a degree of specificity of binding is imparted by the various modifications in terms of changes in capacities or rates of metal ion uptakes. The changes of uptake depend on both the particular ion and the particular protein modification involved. The results show the potential usefulness of the keratin derivatives for removal of toxic and industrial metal ions from water and contribute to interpretation of metal ions interactions with native wool and proteins in general. Treatments of woven wool with aqueous solutions of certain metal salts impart flame and insect resistance to the fabric. (auth)

26510 RELATIONSHIPS BETWEEN STRUCTURES DERIVED FROM COMPLEX HALOGENIDES R_2MX_3. Brink Shoemaker, C. (Oregon State Univ., Corvallis (USA)). Z. Kristallogr.; 137: No. 4, 225-239(Dec 1973).

4 figs.; 4 tabs.; with refs.

The structures of Ba_2FeS_3, aikinite ($PbBiCuS_3$), bismuthinite (Bi_2S_3), Hf_3P_2, and the eta sesquichalcogenides of lanthanides and actinides are related to the structure of the complex halogenide K_2CuCl_3. Similarly, the structures of Ba_2MnS_3, Cr_3C_2, and the A- or α-type lanthanide sesquisulfides are related to the structure of the complex halogenide K_2AgI_3. Both groups of structures consist of packings of large halogen (X) atoms forming triangular prisms, "caps" on the prisms, and tetrahedra. Two thirds of the triangular prismatic interstices are occupied by R atoms. In addition, in R_2MX_3, one third of the tetrahedral interstices are occupied by M atoms. (auth)

Radioactive Waste Treatment

Refer also to abstracts 26527, 27099, 27579, 28653, and 28655.

26511 (ANL-8106) CHEMICAL ENGINEERING DIVISION WASTE MANAGEMENT PROGRAMS. Quarterly Report, January–March 1974. Steindler, M. J.; Levitz, N. M.; Trevorrow, L. E.; Gerding, T. J.; Kullen, B. J.; Webster, D. S.; Burris, L. (Argonne National Lab., Ill. (USA)). May 1974. Contract W-31-109-Eng-38. 20p. Dep. NTIS $4.00.

The problem of decontaminating waste Zircaloy hulls is reviewed as part of the study on consolidation techniques for fuel-cladding hulls. Information is presented from a limited review of the literature concerning application of non-destructive assay techniques for determining plutonium concentrations of plutonium-contaminated metallic equipment. The possibility of separating THO from H_2O by permeation through synthetic polymeric membranes, relevant to the concentration of tritiated water from fuel reprocessing plants, was tested experimentally. Tritiated water was forced by inert gas pressure through three types of membranes, and the samples of permeated and nonpermeated liquids were analyzed for tritium. The separation factors, expressed as ratios of tritium content of nonpermeated liquid to tritium content of permeated liquid, ranged from 0.992 to 1.007, and were much lower than a theoretical separation factor of 1.028 derived from the ratio of self-diffusion coefficients of THO and H_2O. (auth)

26512 (CONF-730907-P1, pp 376-381) ADSORPTION OF FISSION NOBLE GASES ON CHARCOAL. Goldin, A. S.; Underhill, D. W.; Trindade, H. A. (Harvard School of Public Health, Boston). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Further work is reported in correlating the adsorption of Kr and Xe from Ar streams with the adsorption properties of Ar itself. Measurements were made of the adsorption of Kr and Xe from streams of N_2, which may be used as a cover gas in some Fast Flux Test Facility (FFTF) applications. These measurements are also correlated with the adsorption of the N_2 carrier gas. Some additional data on adsorption of the two fission noble gases from air and from a 60:20:20 mixture of N_2-Ar-O_2 are presented. (auth)

26513 (DPSPU-74-30-4) EVALUATION OF MULTISTAGE FILTRATION TO REDUCE SAND FILTER EXHAUST ACTIVITY. Zippler, D. B. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Plant). Jul 1974. Contract AT(07-2)-1. 11p. (CONF-740807-16). Dep. NTIS $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

Air from the Savannah River Plant Fuel Reprocessing facilities is filtered through deep bed sand filters consisting of 8½ feet of gravel and sand. These filters have performed satisfactorily for the past 18 years in maintaining radioactive release levels to a minimum. The apparent filter efficiency has been determined for many years by measurements of the quantity of radioactivity in the air stream before and after the filter. Such tests have indicated efficiencies of 99.9% or better. Even with sand filter efficiency approaching a single stage HEPA filter, new emphasis on further reduction in release of plutonium activity to the environment prompted a study to determine what value backup HEPA filtration could provide. To evaluate the specific effect additional HEPA filtration would have on the removal of Pu from the existing sand filter exhaust stream, a test was conducted by passing a sidestream of sand-filtered air through a standard 24 × 24 × 11½ in. HEPA filter. Isokinetic air samples were withdrawn upstream and downstream of the HEPA filter and counted for alpha activity. Efficiency calculations indicated that backup HEPA filtration could be expected to provide an additional 99% removal of the Pu activity from the present sand-filter exhaust. (auth)

26514 (TID-26626) FY74 PROGRESS REPORT, AEROSOLS AND AEROSOL FILTRATION. Anderson, W. L.; Trigger, A. (Naval Weapons Lab., Dahlgren, Va. (USA)). 1974. Contract AT(49-1)-3628. 21p. Dep. NTIS $4.25.

Experimental data on aerosols and aerosol filtration were developed with respect to AEC problem areas. A series of journal publications on aerosol filtration are listed; filtration theory with confirmatory experimental data was established. The use of semi-porous fibers of alumina and/or zirconia was investigated for high temperature, acid-resistant applications in off gas process filtration. Solid state detectors for aerosols and gases were explored for potential use in production and test environments. A simplified, low-cost photometer cell was developed for use in monitoring unattended spaces for excessive particulate materials. The DOP saturation effect on carbon was investigated and found to be negligible with respect to iodine absorption parameters. (auth)

26515 (WASH-1531(Final)) NEW WASTE CALCINING FACILITY, NATIONAL REACTOR TESTING STATION, IDAHO. Final Environmental Statement. (USAEC, Washington, D.C.). Jun 1974. 145p. Dep. NTIS $10.25.

The environmental effects of the proposed New Waste Calcining Facility are considered and evaluated. (LK)

26516 RADIOCHEMICAL MANAGEMENT ON REACTOR COOLING WATER SYSTEM. II. Radioactive Nuclide Analysis in Feed and Condenser Water System of BWR. Kanbe, H.; Ohtou, Y.; Koyama, H. (Central Research Inst. of Electric Industry, Tokyo). Denryoku Chuo Kenkyusho Gijutsu Kenkyusho Hokoku; No. 73034, VP(Nov 1973). (In Japanese).

In order to elucidate the behavior of radioactive nuclides in the feed and condenser water system of BWR (boiling water reactor), the following are described: (1) the establishment of the quantitative determination of low concentration radioactive nuclides in the system, and (2) the preliminary analysis of the behavior of radioactive nuclides in the system. The main results are summarized as follows: (1) No break-through was found in the concentration procedure of radioactive nuclides with ion exchange in the system under the 110 SV up to 40 l. (2) Ion-exchange resins sample holding concentrated radioactive nuclides could be kept the constant geometrical condition during radiation counting by the improved dry process. (3) By using the procedure described in this report, the sensitivity was about 10^{-10} μCi/ml, and the coefficient of variation was about 20%. (4) Major radioactive nuclides in cruds in the system were ^{60}Co and ^{54}Mn, on the other hand, the major chemical corrosion products were the iron oxides. (auth)

26517 AUTOPRECIPITATION AS A METHOD OF FIXATION OF RADIOACTIVE STRONTIUM. Azzam, A. M.; El-Atrash, A. M.; Ghattas, N. K. (Ain Shams Univ., Cario). J. Appl. Chem. Biotechnol.; 24: No. 4, 261-264(Apr 1974).

The autoprecipitation of strontium ions from alkaline solutions as strontium carbonate by the action of atmospheric carbon dioxide was investigated radiometrically using ^{89}Sr as a tracer. Titanium hydroxide precipitated in situ was found to enhance the autoprecipitation process of strontium ions as carbonate. The method is suggested for strontium fixation from radioactive waste solutions. (auth)

Radioisotope Production

Refer also to abstracts 26434 and 27001.

26518 (BNWL-1831) FLOWSHEET FOR RECOVERY OF CURIUM FROM POWER REACTOR FUEL REPROCESSING PLANT WASTE. Wheelwright, E. J.; Bray, L. A.; Van Tuyl, H. H.; Fullam, H. T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1974. Contract AT(45-1)-1830. 109p. Dep. NTIS $5.45.

Curium-244 has the potential of providing an inexpensive source of power for radioisotope thermoelectric generators. Flowsheets for the recovery of curium from spent-power-reactor fuels were studied and two selected flowsheets were recommended for further development. The flowsheets were designed to process all of the high-level liquid waste from the Barnwell Nuclear Fuel Plant (5 tonnes of fuel per day) with the waste being aged 3 years before processing. Recovery of at least 80% of the curium was desired with a product purity of over 97%. Flowsheets were evaluated with respect to technical feasibility, time of curium availability, relative cost, and impact on waste management. A secondary objective was to include neptunium recovery in the flowsheet. Two flowsheets are described which merit continued development work: 1) a reference flowsheet consisting

of solvent-extraction and ion-exchange steps, and 2) an improved flowsheet using only solvent extraction, but based on incomplete laboratory data. The reference flowsheet consists of the following steps: 1) feed clarification by centrifugation, 2) removal of Pu, Np and U by solvent extraction, 3) acid destruction by reaction with sugar, 4) a second clarification by centrifugation, 5) purification by ion exchange, and 6) waste disposal. The principal advantage of the reference flowsheet is that little additional process development is required, so that early curium availability is possible, while the principal disadvantage is the adverse impact on waste management. The improved flowsheet consists of the same operations for the first four steps, followed by a solvent-extraction process to separate curium from the rare earths, other fission products, and process reagents. A final separation of curium from americium might require a small-scale ion-exchange operation. This flowsheet has the advantages of low cost and minimum impact on wastes, but has the disadvantage of longer lead time before curium availability. Each flowsheet is compatible with a neptunium recovery process demonstrated at the Hanford Purex Plant. Effluent from Step 2 (Pu, Np, U removal) is concentrated, neptunium is further concentrated by solvent extraction, and purified by ion exchange. Additional research and development work is recommended on each of the two curium flowsheets so that options can be kept open for either early recovery of curium or recovery of curium at lowest cost. (auth)

26519 (BNWL-CC-1802) DEVELOPMENT OF CESIUM ISOLATION AND PACKAGING PROTOTYPE EQUIPMENT. Wirta, R. W.; Amos, L. C.; Koski, O. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 22 Aug 1968. 72p. Dep. NTIS $6.75.

The development of process equipment to isolate and package pound quantities of radiocesium is described. A chemical process, called the hydrolysis process, was selected to convert an aqueous slurry of cesium zinc ferrocyanide into a dry, free-flowing cesium chloride powder. Prototype equipment to perform this conversion, suitable for installation in an atomic products plant, was designed, fabricated, and tested. The technical details and cost of this equipment are described. (auth)

26520 (RCN-211) PREPARATION OF AN ISOTONIC ^{18}F SOLUTION. Tjaja, S. A.; Das, H. A. (Stichting Reactor Centrum Nederland, Petten). Mar 1974. 47p. Dep. NTIS (US Sales Only) $5.50.

A procedure is presented for the preparation of isotonic solutions of ^{18}F. The radionuclide is prepared by thermal neutron irradiation of Li_2CO_3 and isolated by steam distillation as HF, adsorption on a Dowex-1 anion exchanger and elution with 1 N HCl. Tritium is eliminated by repeated washing with water of the ion-exchange column. The influence of the various experimental variables on the amount of ^{18}F-activity produced is described quantitatively. The highest specific activity is obtained by irradiation of the Li_2CO_3 in a thin layer and taking only the central fraction of the eluate of the anion-exchange column. Irradiation for 6 hours in a thermal neutron flux of $5 \cdot 10^{13}$ $cm^{-2}sec^{-1}$ results in a maximal specific activity of 6 mCi/ml. The tritium content of the final product is $\leq$0.01 mCi/ml. (auth)

26521 TECHNETIUM-99m GENERATORS. Charlton, J. C. (to Radiochemical Centre Ltd.). US Patent 3,827,986. 6 Aug 1974. Priority date 6 Aug 1971, United Kingdom of Great Britain and Northern Ireland. 6p.

Yields of technetium-99m, obtained by elution from generators comprising molybdenum-99 adsorbed on an ion-exchange material, are improved by incorporating a hydrated electron scavenger, particularly nitrate or nitrite ion, at low concentration in the aqueous fluid of the generator and/or in the eluant. (Official Gazette)

26522 CHOICE OF THE OPTIMUM VALUE FOR THE CONCENTRATION OF THE KEY ISOTOPE IN THE WASTE SECTION OF A CASCADE USED IN SEPARATING MULTICOMPONENT ISOTOPE MIXTURES. Kolokol'tsov, N. A.; Laguntsov, N. I.; Sulaberidze, G. A. Sov. At. Energy (Engl. Transl.); 35: No. 2, 749-750(Aug 1973).

Translated from At. Energ. (USSR); 35: No. 2, 127-128(Aug 1973).

So-called Q-cascades can be used for separating a multicomponent isotope mixture into two groups: a lighter group and a heavier group. The separation in the cascade takes place in such a way that the isotope concentrations in one group (including the intermediate key isotope or the generated isotope) in the outlet of the cascade will increase, while the concentrations of the other group will sharply decrease. Since enrichment takes place in the entire group, the concentration of the key isotope in the outlet of the Q-cascade will be bounded. A method for determining the limiting value for the concentration of the key isotope is given. (LK)

Reactor Fuel Reprocessing

Refer also to abstract 27581.

26523 (AED-CONF-74-157-004) MONITORING OF RADIOACTIVE GASEOUS EFFLUENTS IN THE GERMAN REPROCESSING PLANT WAK. Finsterwalder, L.; Hoffmann, W.; Huppert, K. L. (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen m.b.H., Leopoldshafen (F. R. Germany)). 1974. 5p. INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

3 figs.; 1 tab. With abstract.

The WAK off-gas monitoring system is described. All medium and low-level radioactive liquid wastes of the plant are transferred to the effluent treatment station of the Nuclear Research Center Karlsruhe, and no liquid active effluents are directly released to the environment. The gaseous effluents from room and vessel ventilation systems are continuously monitored for aerosols and radioactive gases (noble gases iodine). Tritium is determined by sampling of condensate in the off-gas stream. Operating experience with the monitoring station is reported. (auth)

26524 (CONF-740814-1) REDUCTION IN CAPITAL COSTS OF FUEL REPROCESSING PLANTS. Costello, J. M.; Levins, D. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1973. 40p. Dep. NTIS (US Sales Only) $5.00.

From AINSE engineering conference; Lucas Heights, Australia (19 Aug 1974).

A comparison was made between the capital cost structure of aqueous reprocessing plants and conventional chemical plants. Plant design and plant requirements that incorporate themes for cost reduction are described. Comparisons are made for cost intensive process functions such as fuel pre-breakdown, shear-leaching, and solvent extraction. A basis for the costing of design is given. (AT)

26525 (CONF-740917-1) MASS TRANSFER OF WATER FROM SINGLE AQUEOUS SOL DROPLETS FLUIDIZED IN A PARTIALLY MISCIBLE ALCOHOL. Clinton, S. D. (Oak Ridge National Lab., Tenn. (USA)). 1974. 31p. Dep. NTIS $3.75.

From international solvent extraction conference; Lyon, France (8 Sep 1974).

During the preparation of sol-gel microspheres, droplets of the aqueous sol must be suspended or fluidized in an organic phase until enough water is extracted from the sol to cause gelation. The rate of mass transfer was investigated by fluidizing single water or thoria sol droplets in a partially miscible alcohol and measuring their diameters as a function of time. Three alcohols were studied: 2-ethyl-1-hexanol, 2 methyl-1-pentanol, and n-hexanol. The first alcohol was studied at 25, 40, and 50°C, whereas the remaining two were studied at 25°C only. The Schmidt numbers for these systems ranged between 5,000 and 36,000, and the sphere Reynolds number varied from 0.2 to 30. A surface-active agent, Ethomeen S/15, was added to the organic phase to produce a rigid liquid drop with no induced circulation. By relating the tangential velocity at the drop interface to the sphere drag coefficient, an expression for the Sherwood number was derived and then confirmed experimentally for both water and sol drop data. An explicit relationship for the mass transfer coefficient was found to be independent of the drop diameter, and an expression was obtained to predict the gelation times of thoria sol droplets from known sol and solvent properties. (auth)

26526 (JUL-1042-RG) PROBLEMS OF THE FUEL CYCLE IN HIGH TEMPERATURE REACTORS. Hoffmann, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Jan 1974. 114p. (In German). Dep. NTIS (US Sales Only) $8.75.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

This report presents the variations of the fuel cycle, the fuel element geometry and the fuel handling in High Temperature Reactors. Mainly the differences between reactors with spherical and reactors with prismatic fuel elements are shown. The attitudes, which are important for the handling and further treatment of burnt up fuel elements, are discussed for the fuel elements of the PR 500. For waste disposal different solutions are proposed and compared. (auth)

26527 (K-L-6338) ABSORPTION PROCESS FOR REMOVING KRYPTON FROM THE OFF-GAS OF AN LMFBR FUEL REPRO-

CESSING PLANT. Stephenson, M. J.; Dunthorn, D. I.; Reed, W. D.; Pashley, J. H. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 1974. 12p. (CONF-740807-13). Dep. NTIS $4.00.

From 13th air cleaning conference; San Francisco, California, USA (12 Aug 1974).

The Oak Ridge Gaseous Diffusion Plant selective absorption process for the collection and recovery of krypton and xenon is being further developed to demonstrate, on a pilot scale, a fluorocarbon-based process for removing krypton from the off-gas of an LMFBR fuel reprocessing plant. The new ORGDP selective absorption pilot plant consists of a primary absorption-stripping operation and all peripheral equipment required for feed gas preparation, process solvent recovery, process solvent purification, and krypton product purification. The new plant is designed to achieve krypton decontamination factors in excess of 10^3 with product concentration factors greater than 10^4 while processing a feed gas containing typical quantities of common reprocessing plant off-gas impurities, including oxygen, carbon dioxide, nitrogen oxides, water, xenon, iodine, and methyl iodide. Installation and shakedown of the facility were completed and some short-term tests were conducted early this year. The first operating campaign using a simulated reprocessing plant off-gas feed is now underway. The current program objective is to demonstrate continuous process operability and performance for extended periods of time while processing the simulated "dirty" feed. This year's activity will be devoted to routine off-gas processing with little or no deliberate system perturbations. Future work will involve the study of the system behavior under feed perturbations and various plant disturbances. (auth)

26528 (WASH-1534(Final)) HTGR FUELS REPROCESSING FACILITIES, NATIONAL REACTOR TESTING STATION, IDAHO. Final Environmental Statement. (USAEC, Washington D. C.). Aug 1974. 239p. Dep. NTIS $15.00.

This environmental impact statement was prepared in accordance with the National Environmental Policy Act of 1969 in support of the U. S. Atomic Energy Commission's proposal for legislative authorization and appropriation for a FY 1975 project. The purpose of this project is to (1) demonstrate the technology for reprocessing irradiated fuel from High Temperature Gas Cooled Reactors operating on the thorium fuel cycle; and (2) provide an interim reprocessing facility for HTGR fuels which may be accepted by AEC under its Chemical Processing Policy. This project will consist of a small addition to and modification of a portion of the existing Idaho Chemical Processing Plant (ICPP) to provide the capabilities for HTGR fuel reprocessing. The demonstration phase of the project will be coordinated with the HTGR Fuel Refabrication Pilot Plant that is planned for installation in the Thorium Uranium Recycle Facility (TURF) at the Oak Ridge National Laboratory (ORNL) at Oak Ridge, Tennessee. These projects complement each other in the development of HTGR fuel recycle technology. (LK)

26529 IRRADIATED FUEL PROCESSING SYSTEM. Kendall, W. R. (to General Electric Co.). US Patent 3,827,579. 6 Aug 1974. Filed date 2 Nov 1970. 18p.

A system for handling irradiated nuclear reactor fuel bundles preparatory to reprocessing the irradiated fuel contained therein is disclosed. This system includes a fuel bundle clamping table including means to remove bundle end fittings and to clamp the bundle in a fixed position while permitting longitudinal movement of the fuel rods through the bundle; a fuel rod pulling assembly including means for pulling fuel rods from the bundle, for handling the rods and for collecting groups of rods; a shear feed assembly inciuding means to feed groups of fuel rods incrementally to a shear; and a shear assembly including means to simultaneously cut two small pieces from the end of each rod of a set with each shearing stroke. A process for performing the above-indicated operations is also disclosed. This system is simple, reliable and capable of being remotely operated, disassembled and modified. (Official Gazette)

CONTROLLED THERMONUCLEAR RESEARCH

Confinement and Heating

Refer also to abstracts 26610, 26634, and 26649.

26530 (LA-5611-MS) EVIDENCE OF ANOMALOUSLY REDUCED ELECTRON THERMAL CONDUCTION IN LASER-PRODUCED PLASMAS. Ehler, A. W.; Giovanielli, D. V.; Godwin, R. P.; McCall, G. H.; Morse, R. L.; Rockwood, S. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 6p. Dep. NTIS $4.00.

Experimental results and complimentary theoretical arguments are presented which suggest that electron thermal conduction in laser-produced plasmas is anomalously reduced. This reduction is thought to occur in the low-density plasma near the critical surface when absorbed power densities are sufficiently large and to be caused by the counterstreaming of cold electrons relative to ions required by thermal conduction. (auth)

26531 (LA-tr-74-26) INVESTIGATION OF ELECTRON HEATING DURING FAST MAGNETIC COMPRESSION OF LOW DENSITY PLASMA USING LIGHT SCATTERING DIAGNOSTICS. Maret, G. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1973. Translation of IPP-1/133. 43p. Dep. NTIS $5.25.

In a high-voltage theta pinch (charging voltage 500 kV, coil diameter 43 cm, coil length 100 cm) heating of low density plasmas (initial density $n_0 \sim 1 \times 10^{13}$ cm^{-3}) to thermonuclear temperature ($T_i \sim 15$ keV) is achieved by extremely fast magnetic shock compression. Electron heating and loss mechanisms during and after compression are studied. (auth)

26532 (SLA-74-5254) LOW ENERGY X-RAY MICRORADIOGRAPHY OF LASER FUSION TARGETS. Prevender, T. S.; Lynch, A. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 11p. (CONF-740809-9; SAND-74-0103). Dep. NTIS $4.00.

From 23rd annual conference on applications of x-ray analysis; Denver, Colorado, USA (7 Aug 1974).

A low energy x-ray radiography apparatus was developed primarily for the nondestructive inspection of LiD laser fusion targets. Exposure times of 15 minutes at 6 keV have been found satisfactory for the detection of voids in nominal 100 micron diameter spheres. (auth)

26533 (UCID-15766) PLASMA TRAPPING ENHANCEMENT THROUGH PHOTO-IONIZATION. Osher, J. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1970. 7p. Dep. NTIS $4.00.

The efficiency of low-energy neutral beam injection into experimental magnetic containment geometries is currently limited by the low beam fraction available in sufficiently high excited states for Lorentz ionization and trapping. The use of photoionization of the lower excited states is presented as a means of increasing this efficiency by approximately an order of magnitude. The system includes the beam trapping region within the optical cavity of a high-power laser to increase the available photon flux density. Photon enhanced trapping appears particularly attractive for the case of low-energy injection into a weak magnetic field. The trapping efficiency of both photo-ionization and Lorentz ionization will saturate, because they depend upon the population available in excited states. Higher efficiency trapping requires sufficient plasma for ground state ionization of the neutral beam passing through. (auth)

26534 MEASUREMENTS OF ELECTRON–CYCLOTRON HEATING RATES. Barter, J.D.; Sprott, J.C.; Wong, K.L. (University of Wisconsin, Madison, Wisconsin 53706). Phys. Fluids 17: No. 4, 810-812 (Apr 1974).

Electron–cyclotron heating rates have been measured for plasmas in a toroidal octupole magnetic field over a wide range of magnetic field strength, electric field strength, plasma density, and neutral density. The results agree with single–particle heating theories at low densities but show a decreased heating rate as the density increases. (auth)

26535 EFFECT OF MAGNETIC FIELD SPACE PERTURBATIONS IN TOROIDAL PLASMAS IN THE INTERMEDIATE DIFFUSION REGIME. Casati, G.; Lazzaro, E.; Orefice, A. (Laboratorio di Fisica del Plasma ed Elettronica Quantistica del Consiglio Nazionale delle Ricerche, Istituto di Fisica, 16 Milano, Italy). Phys. Fluids 17: No. 4, 847-848 (Apr 1974).

The realistic situation of slight, space–dependent magnetic perturbations superimposed on the usual magnetic field in axisymmetric toroidal machines is treated on the basis of kinetic equations in the drift approximation. It is shown that the radical component of such perturbations may cause an enhanced plasma loss. (auth)

26536 MAGNETIC COMPRESSION OF INTENSE ION RINGS. Sudan, R.N.; Ott, E. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14850). Phys. Rev. Lett. 33: No. 6, 355-358 (5 Aug 1974).

It is shown how Lawson criterion for controlled fusion might be achieved by magnetic compression of intense ion rings to field reversal. (auth)

26537 HEATING OF A FULLY IONIZED PLASMA COLUMN BY A RELATIVISTIC ELECTRON BEAM. Ekdahl, C.; Greenspan, M.; Kribal, R.E.; Sethian, J.; Wharton, C.B. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14850). Phys. Rev. Lett. 33: No. 6, 346-348 (5 Aug 1974).

A magnetized plasma column ($n_p \leq 6 \times 10^{13}$ cm^{-3}) is heated by the injection of an intense relativistic electron beam along the magnetic field. The energy per electron–ion pair transferred to the plasma increases linearly with the beam–to–plasma density ratio n_b/n_p. The electron heating is attributed to the electron–electron beam–plasma interaction while the energetic ions are produced by an electrostatic acceleration. After heating, the plasma column oscillates radially at a frequency proportional to $B/n_p^{1/2}$. (auth)

26538 ABLATION STABILITY OF LASER–DRIVEN IMPLOSIONS. Henderson, D.B.; McCrory, R.L.; Morse, R.L. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Rev. Lett. 33: No. 4, 205-208 (22 July 1974).

Perturbation analysis of the stability of ablative, laser–driven implosions of homogeneous spherical pellets shows stability of the ablation surface, a necessary condition for achieving the high densities required for laser fusion. This conclusion is supported by physical arguments. (auth)

26539 EFFECT OF A TRANSVERSE MAGNETIC FIELD ON PLASMA CONFINEMENT IN A STELLARATOR AND A TORSATRON. Voitsenya, V.S.; Voloshko, A.Y.; Georgievskii, A.V.; Ziser, V.E.; Solodovchenko, S.I.; Slyusarenko, S.Y. Sov. Phys.–Tech. Phys. 18: No. 11, 1456-1459 (May 1974).

Computer calculations have been carried out for the magnetic surfaces. For both the stellarator and torsatron modes of the Saturn–1 there are closed magnetic surfaces at transverse magnetic fields $H_\perp/H_0 \gtrsim 2\%$. An experimental study is made of plasma confinement as a function of the transverse field in this range. The plasma, produced by a titanium source, has the following parameters: $n_e \sim 10^{10}$ cm^{-3}, $T_e \sim 10$ eV, and $T_i \sim 20$ eV. The confinement time of such a plasma is shown to have the functional dependence on the parameters of the closed magnetic surfaces predicted by neoclassical theory. (auth)

26540 INCREASE IN PLASMA ENERGY DUE TO HIGH–FREQUENCY PARAMETRIC PUMPING. Demirkhanov, R.A.; Khorasanov, G.L. (Sukhumi Physicotechnical Institute). High Temp. 11: No. 5, 985-987 (May 1974).

We have studied the electron temperature as a function of the frequency of an external magnetic field.

26541 PLASMA CONFINEMENT IN A TIME–INCREASING MULTIPOLE MAGNETIC FIELD. Padalka, V.G.; Repalov, N.S. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Tech. Phys. 19: No. 1, 121-122 (July 1974).

The motion of plasma particles in a multipole–type magnetic trap is studied when the current producing the magnetic field configuration increases in time. The trajectories of the particles are established and it is shown that the plasma is confined in a narrow region near the separatrix. (auth)

26542 SPATIAL CHARACTERISTICS AND LOSS OF PLASMA PRODUCED BY AN ELECTRON BEAM IN A MAGNETIC TRAP. Bredikhin, M.Y.; Maslov, A.I.; Skibenko, A.I.; Skibenko, E.I.; Fomin, I.P.; Yuferov, V.B. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Tech. Phys. 19: No. 1, 49-52 (July 1974).

An experimental study has been made of the spatial characteristics of the plasma produced by the interaction of a high–current electron beam with a dense gas target in the center of a magnetic mirror. The average plasma dimensions and the radial profile of the density in the transverse cross section have been determined by probing the plasma at $\lambda = 4$ and 8 mm. These measurements yield the radial dimensions of the plasma column, the spatial profile of the plasma density, the total number of particles per unit length of the trap, and the degree of ionization of the plasma. It is concluded on the basis of these results that the most important mechanism for plasma loss from the trap during the active period of the discharge is loss of plasma in the mirror. (auth)

26543 OPTICAL FREQUENCY MIXING NEAR THE CYCLOTRON FREQUENCY FOR PLASMA HEATING. Capjack, C.E.; James, C.R. (Department of Electrical Engineering, The University of Alberta, Edmonton 7, Alberta, Canada). Phys. Fluids 17: No. 5, 948-953 (May 1974).

The nonlinear mixing of two laser beams to drive a mode with a frequency near the cyclotron frequency of either the electrons or ions for plasma heating is investigated. The beat frequency wave that is generated is not required to be a natural mode in the plasma. As a result, the heating scheme is considerably less sensitive to fluctuations in the magnetic field, the plasma density, and in the frequencies of the mixing laser beams than in the case where a natural mode in the plasma is generated. The results that are obtained predict a considerable enhancement in the power absorption by the plasma in a region within the volume of interaction of the two laser beams. The extent of the strongly heated region is determined by the transfer of energy from the higher frequency laser to the lower frequency laser as the two beams propagate through the region of interaction. (auth)

26544 STRAIGHT AND TOROIDAL PLASMA EQUILIBRIA WITH AN INTENSE RELATIVISTIC ELECTRON CURRENT COMPONENT. Mondelli, A. (Maxwell Laboratories, Inc., San Diego, California 92123); Ott, E. Phys. Fluids 17: No. 5, 1017-1025 (May 1974).

The equilibrium of an axisymmetric, large aspect-ratio, finite temperature toroidal plasma enclosed by a perfectly conducting toroidal container is studied analytically. The new feature of the analysis is the presence of a relativistic electron beam which circulates around the torus thus producing a poloidal magnetic field in addition to the external field and the field created by currents in the plasma. This problem may be of interest in connection with recent toroidal beam injection experiments at Cornell University and in tokamaks. The equilibria are obtained from the relativistic virial theorem. Specific examples are given wherein the plasma pressure is characterized by its dependence on the magnetic flux function and the relativistic electron beam is characterized by an electron distribution function which is a delta function in energy and canonical momentum in the toroidal direction. (auth)

26545 ANGULAR DISTRIBUTION FUNCTION FROM AXIAL DENSITY MEASUREMENTS IN A MIRROR CONFINEMENT EXPERIMENT. Hall, L.S.; Simonen, T.C. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 17: No. 5, 1014-1016 (May 1974).

The angular distribution of particle velocities in a magnetized plasma can be uniquely determined by measurement of the variation of density along a magnetic field line. From measurements on the 2XII mirror experiment, it is determined that the angular distribution of ions is monotonic and very closely approximates $\sin^{2a}\theta$, where $a=2.25$ and θ is the pitch angle at the center. Particles with $\sin\theta<0.72$ communicate with the region outside the mirrors and comprise approximately 5% of the total density at the center. (auth)

26546 MOMENTUM OF PHOTONS AND THE NONLINEAR FORCE OF LASER-PLASMA INTERACTION. Hora, H. (Max-Planck-Institut für Plasmaphysik, 8046 Garching, Germany). Phys. Fluids 17: No. 5, 1042-1043 (May 1974).

The momentum of photons in a collisionless plasma reproduces the Fresnel formulas only if the energy exchange with electrons is included. The transferred momenta correspond exactly to those derived from the theory of the nonlinear force of a laser-plasma interaction. (auth)

26547 ELECTRON HEATING DUE TO PARAMETRIC INSTABILITY TURBULENCE. Thomson, J.J.; Faehl, R.J.; Kruer, W.L.; Bodner, S. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 17: No. 5, 973-980 (May 1974).

The turbulent electron heating due to laser-plasma instabilities at the critical density (laser frequency equals plasma frequency) is considered. In the regime where the laser energy is much less than the plasma thermal energy, simulations show that the wave energy spectrum takes on approximate k^{-2} shape concomitant with the formation of a suprathermal electron tail. Test particle calculations demonstrate that these tails are produced by velocity space diffusion due to the plasma waves. Quasilinear theory predicts a linear heating rate and an exponential shape for the electron tail, in agreement with the simulation result. The fluid equations, including mode coupling terms, are solved, and it is found that the instability saturation level and k^{-2} spectrum are due to mode coupling. Using the resulting fields, the electron distribution function is evolved, giving reasonable heating rates and suprathermal tail formation. Calculations in the underdense region (laser frequency greater than plasma frequency) show that the heated distribution function has fewer high energy electrons. Finally, an approximate analysis of heating in a finite interaction region is given. (auth)

26548 MAGNETIC COMPRESSION AND ELECTRON CYCLOTRON HEATING OF A LOW TEMPERATURE, LITHIUM PLASMA. Kim, J.; Lieberman, M.A. (Department of Electrical Engineering and Computer Sciences, Electronics Research Laboratory, University of California, Berkeley, California 94720). Phys. Fluids 17: No. 3, 559-565 (Mar 1974).

Magnetic mirror compression and electron cyclotron heating have been investigated in a high field, simple mirror, compression device (midplane field rises from 200 G to 50 kG in 0.5 msec, mirror ratio=1.4), using a contact ionization lithium source ($n\simeq10^8-10^{10}$ cm^{-3}, $T_e=T_i\simeq0.2$ eV) to produce the initial plasma. Experimental results are: (1) For magnetic mirror compression, the plasma is macroscopically unstable, and, although $T_i\simeq10$ eV, confinement is destroyed with ~200 μsec, for all ranges of initial plasma density and neutral pressure. A set of rate equations for electron and ion density and temperature and ambipolar potential predicts classical confinement times of the order of milliseconds. (2) For short pulse, electron cyclotron heating (250 kW, 0.25 μsec, 8.95 GHz pulse) followed by magnetic compression, $T_e\simeq45$ keV, $T_i\simeq10$ eV and the plasma is stably confined, provided the neutral gas pressure exceeds $\sim2\times10^{-5}$ Torr. The observed stability is in rough agreement with the Guest-Beasley criterion for stabilization of flute modes by flow of cold plasma to the conducting chamber walls. The confinement time is in agreement with previous rate equation calculations of hot electron plasma confinement in magnetic mirrors. (auth)

26549 HEATING OF A PLASMA WITH A FREQUENCY FEEDBACK SYSTEM. Ogata, A.; Watari, T.; Shoji, S.; Hiroe, S.; Sato, T.; Jacquinot, J. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Phys. Lett., A; 48: No. 3, 193-194(17 Jun 1974).

It is well known that plasma ions can be heated by an rf field in the vicinity of the ion cyclotron frequency provided the frequency matches an electrostatic ion cyclotron mode. When an rf field with a fixed frequency is applied to a transient plasma, heating occurs only during the time interval where the plasma parameters are nearly resonant to the given frequency. This paper reports a transient plasma can be heated throughout its lifetime by tuning the frequency of the rf field according to the plasma parameters. (auth)

Diagnostics

Refer also to abstracts 26665 and 28738.

26550 (AD-775051) ION BEAM PROBE DIAGNOSTIC TECHNIQUE FOR LABORATORY PLASMAS. Reinovsky, R. E. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA). Plasma Dynamics Lab.). Aug 1973. 293p. (RPDL-73-13; AFOSR-TR-74-0242). NTIS $6.75.

Ion beam probing was shown to be a general purpose diagnostic tool for magnetically confined plasmas. A complete system was designed, constructed, and operated on a number of laboratory plasmas to demonstrate the applicability of beam probing to laboratory devices. The results demonstrate that the advantages of ion beam probing can be achieved with modest expenditure of time and resources. The various components of a complete beam probe system were investigated theoretically and experimentally for the first time. The results show that the beam probe system is dominated by electron impact ionization, as expected, that simple detectors have several limitations, and that the feedback controlled electrostatic energy analyzer demonstrates the spatial and time resolution expected from the theoretical analysis. (auth)

26551 (DLR-FB-72-36) DIAGNOSTICS OF NITROGEN PLASMA JETS IN THERMODYNAMIC NON-EQUILIBRIUM. Sprengel, U. W. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Braunschweig (F. R. Germany). Inst. fuer Elektrische Antriebe und Energieversorgung; Technische Univ. Braunschweig (F. R. Germany)). 1972. 109p. (In German). INIS.

38 figs.; 35 refs. With abstract in German and English. Available from the library of Technische Univ. Braunschweig.

The effect of an elevated electron temperature above the heavy particle temperature on the diagnostics of nitrogen plasma jets is investigated. It is shown in which way the steady-state properties can be determined from the given values of the specific enthalpy, pressure and electron temperature in the stagnation point. For this purpose the following two extreme cases are considered during stagnation: 1. Equilibrium of dissociation and ionization as well as a constant degree of thermodynamic non-equilibrium. 2. Constant relative plasma composition and specific partial entropies. (GE)

26552 (LRP-85/74) EXPERIMENTAL AND COMPUTATIONAL STUDY OF THE LOW-DENSITY PLASMA IN THE

OUTER REGIONS OF A THETA PINCH. Hafner, P.; Hofmann, F. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Jul 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

The time evolution of the electron density was measured in the outer regions of a fast theta pinch by means of a Mach–Zehnder interferometer. The results show that the electron density outside the central plasma column is relatively high, i.e., between 1 and 5×10^{14} cm^{-3}. A comparison of these measurements with theoretical calculations leads to the conclusion that the pinch must be unstable during the implosion phase. (auth)

26553 (SLA-74-5270) PINHOLE CAMERA FOR PHOTOGRAPHING X RAYS FROM LASER-PRODUCED PLASMAS. Hohlfelder, J. J.; Palmer, M. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 10p. (CONF-740809-4). Dep. NTIS $4.00.

From 23rd annual conference on applications of x-ray analysis; Denver, Colorado, USA (7 Aug 1974).

A pinhole camera was used to record low-energy x rays produced from CD_2 microsphere irradiation with Sandia Laboratories' four-beam, pulsed laser system. Camera useful energy range, spatial resolution, and x-ray energy sensitivity are discussed. Camera x-ray energy sensitivity which was determined by laboratory calibration is compared with measurements obtained with a multichannel x-ray spectrometer. X-ray photographs of laser-irradiated microspheres are presented. Spatial information about the x-ray source derived from these photographs is discussed. (auth)

26554 (UCID-16569) EFFECTS OF DEBYE SCREENING ON THE POSITION OF SPECTRAL LINES. Tarter, C. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1974. Contract W-7405-eng-48. 10p. Dep. NTIS $4.00.

The effects of Debye screening on the position of spectral lines, particularly the Lyα resonance line of hydrogen-like atoms, are described. There are many theoretical approaches to the problem of continuum lowering in plasmas, the Debye theory being one of the simplest. Unfortunately, the spectral line shifts predicted by all such theories are first order rather than zero order quantities: most physical properties of interest, such as the equation of state and radiative opacity, are sensitive to the average magnitude of the continuum lowering but relatively insensitive to the differential effects on different quantum states. In addition the Debye picture certainly breaks down as $d \to 1$ and is probably obscured by other phenomena for $d \gg 1$. However, if it is to have any validity it should produce at least semi-quantitative accuracy for intermediate values, say $10 \lesssim d \lesssim 100$, so that the predicted line shifts in this regime can initially be treated with some measure of confidence. (auth)

26555 (UCRL-75616) SILICON DETECTOR SYSTEM FOR X-RAY PULSE CALORIMETRY. McQuaid, J. H.; Violet, C. E.; Petruzzi, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Aug 1974. 11p. (CONF-740809-8). Dep. NTIS $4.00.

From 23rd annual conference on applications of x-ray analysis; Denver, Colorado, USA (7 Aug 1974).

The instrumentation for measuring x-ray yields from laser-produced plasma is described. This new type of calorimeter is composed of a silicon detector, a charge-sensitive preamplifier and an analog-to-digital readout scheme for multiplexing up to ten detector outputs. X-rays interacting with the detector produce hole-electron pairs in proportion to the total energy lost in the detector ($\sim 10^{12}$ eV). In this application the detector can be characterized as a solid-state ionization chamber. The detector signal is coupled to a charge-sensitive preamplifier which generates a voltage pulse proportional to the x-ray energy absorbed. In this way the x-ray energy is measured by "direct conversion" rather than measuring the temperature rise due to an energy flux. (auth)

26556 CONTINUUM THEORY OF SPHERICAL ELECTROSTATIC PROBES IN A STATIONARY, MODERATELY IONIZED PLASMA. Barad, M.S.; Cohen, I.M. (Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Fluids 17: No. 4, 724-734 (Apr 1974).

A theory is developed for spherical electrostatic probes in a stationary, collision–dominated plasma in which the ratio of charge–charge to charge–neutral collision frequencies may range between zero and unity. The former limit corresponds to the usual "weakly ionized" condition of earlier probe analyses, while for non–zero values of this ratio, transport coefficients must be assumed to vary with position in the plasma. Electron temperature variation is allowed for through the consideration of electron energy conservation and transport. Quasilinearization is used to solve the equations numerically, and an orthonormalization technique is developed to overcome the "ill–conditioning" problem which often occurs in the solution of linear two–point boundary value problems. Plasma property profiles in the vicinity of the probe, for several values of collision frequency ratio and a wide range of probe potentials, are investigated. A few representative current–voltage characteristics are calculated. The effects of including variable transport coefficients in the formulation are discussed. It is found that including charge–charge collisions increases the effective positive bias of an electron–attracting probe, and of a probe at plasma potential, and more effectively shields an electron–retarding probe of low potential. For more strongly retarding probes, this trend reverses and shielding is decreased (although very slightly). For stongly retarding probes, there is no apparent difference between the bahavior of weakly and moderately ionized gases. A systematic procedure is developed by which experimentally obtained probe characteristics may be interpreted. (auth)

26557 TIME RESOLVED ABSOLUTE X-RAY MEASUREMENTS ON LASER–PRODUCED PLASMAS. Key, M.H.; Eidmann, K.; Dorn, C.; Sigel, R. (Max–Planck–Institut für Plasmaphysik, 8046 Garching, Germany). Appl. Phys. Lett. 25: No. 6, 335-337 (15 Sept 1974).

The absolute intensity of soft x–ray emission from laser–generated plasmas has been studied with vacuum photodiodes of 1.0–nsec time resolution. (auth)

26558 A POSSIBLE WAY TO MEASURE THE TEMPERATURE OF A GAS–DISCHARGE PLASMA BY USING THE INTENSITY OF ITS NOISES. Zeigarnik, V.A.; Matsenko, A.B. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 11: No. 6, 1160-1161 (July 1974).

It is experimentally demonstrated that temperature measurement of a plasma by using the intensity of its noises yields reasonable results and agrees with spectroscopic measurements.

26559 PROBE MEASUREMENTS IN A COLD, DENSE HIGHLY IONIZED PLASMA. Baksht, F.G.; Dyuzhev, G.A.; Mitrofanov, N.K.; Shkol'nik, S.M.; Yur'ev, V.G. (A. F. Ioffe Physictoechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Tech. Phys. 18: No. 12, 1617-1622 (June 1974).

In a theoretical and experimental study of the operation of an electrostatic probe it is shown that the electron temperature determined from the initial region of the electron branch of the probe characteristic agrees satisfactorily with the value found by the optical method. The reliableness of the determination of the plasma density is a function of the degree of ionization.

26560 SPECTROSCOPIC DETERMINATION OF ELECTRON CONCENTRATION IN THE ARC OF A DUOPLASMATRON ION SOURCE. Abroyan, M.A.; Kagan, Y.M.; Kolokolov, N.B.; Lavrov, B.P. Opt. Spectrosc. (USSR) 36: No. 4, 375-377 (Apr 1974).

The electron concentration in the hydrogen plasma of the arc of a duoplasmatron ion source is measured using Stark broadening of the H_β line. Profiles are measured with a Fabry–Perot interferometer crossed with a diffraction monochromator. Wavelength scanning is accomplished by varying. The angle of inclination of the interferometer. The instrumental profile is determined experimentally. Under the duoplasmatron operating conditions investigated ($P = 0.07–0.2$ Torr and $i = 0.2–2.0$ A) the electron concentration is approximately 10^{14} cm^{-3} and is weakly dependent on discharge current and pressure. (auth)

26561 DIELECTRIC IMPURITIES AND SURFACE INSTABILITY IN LANGMUIR PROBE PLASMA MEASUREMENTS. D'Arcy, R. J. (Univ. of Birmingham, Eng.). J. Phys., D (London); 7: No. 10, 1391-1401 (Jul 1974).

Dielectric impurities on Langmuir probes are shown to be a source of surface instability in plasma measurements. The probe work function becomes current-dependent due apparently to electrostatic charging rendering the probe characteristic to become distorted. This instability can also give rise to the related phenomena of current hysteresis. (auth)

26562 DETERMINATION OF THE ELECTRON DENSITY OF A PLASMA WITH A THREE–MIRROR SUBMILLIMETER LASER INTERFEROMETER. Kolerov, A.N.; Petrov, G.D. (All–Union Scientific–Research Institute of Physicotechnical and Radio Engineering Measurements). High Temp. 11: No. 5, 983-984 (May 1974).

We give the results of a recent measurement of plasma electron density. The laser interferometer employed is discussed in detail. (AIP)

26563 PEAK STRENGTH OF SELF–REVERSED LINES. Fishman, I.S.; Nurmatov, É.M. (Kazan State University). High Temp. 11: No. 5, 848-853 (May 1974).

The peak strength of self–reversed spectral lines is calculated. The multiplier M_∞ of Bartels' theory for the case of an arc discharge was determined with consideration of the real distribution of temperature

and concentration of atoms along the line of sight. The multiplier Y_∞ was determined from calculations made according to the Cowan–Dicke model for the case of symmetric self–reversal. Simple relations associating M_∞ and Y_∞ with the inhomogeneity parameter n of the Cowan–Dicke theory are obtained. The calculations are used for determining the temperature of the arc on the discharge axis on the basis of the resonance and nonresonance lines of the elements. The limitations of Bartels' theory with respect to resonance lines are removed. (auth)

26564 DIAGNOSTICS OF A LASER–PRODUCED PLASMA BY A SCATTERING METHOD USING AN ELECTRON–OPTICAL IMAGE CONVERTER. Burunov, E.A.; Malyshev, G.M.; Razdobarin, G.T.; Semenov, V.V. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Tech. Phys. 19: No. 1, 66-69 (July 1974).

A scattering method is used to study a spark in air at atmospheric pressure at times from 1.5 to 60 μsec after the spark is initiated. Radial profiles of the electron density are obtained in a single laser pulse by means of an electron–optical image converter. There is a high electron density in the plasma at distances out to 2 mm from the center of the spark. The dimensions of this region fall off as a function of the time and the density at the center of the spark falls off from $2\cdot10^{18}$ to $3\cdot10^{16}$ cm^{-3}. (auth)

26565 POSITIVE COLUMN OF Na–Ar AND Na–Ne–Ar DC LOW–PRESSURE DISCHARGES. H. van Tongeren; Heuvelmans, J. (Philips Research Laboratories, Eindhoven, The Netherlands). J. Appl. Phys. 45: No. 9, 3844-3850 (Sept 1974).

Measurements are reported of the electron temperature, electric field, and electron density in the positive column of low–pressure Na–Ar and Na–Ne–Ar dc discharges. The production of light at the sodium D resonance lines was also measured. The experimental data were obtained for a tube radius of 1.4 cm, and a noble gas filling of 10 Torr. The sodium density varied from 1×10^{19} to 6×10^{19} m^{-3}, and the discharge current from 0.1 to 3.0 A. Depletion of sodium ground–state atoms was found to have a decisive effect on the discharge properties at the higher discharge currents. Calculations on a model of the discharge were performed in addition to the measurements. In this model deviations from the Maxwell electron energy distribution were included. The results of the calculations for the electron temperature as a function of current were found to be in good agreement with the experimental data. However, the calculated electric field as a function of current showed qualitative agreement only. (auth)

26566 OBSERVATIONS ON MAGNETICALLY INDUCED ANODIC–ARC–REGION BEHAVIOR. Murphree, D.L.; Carter, R.P. (Department of Aerophysics and Aerospace Engineering, Mississippi State University, Mississippi State, Mississippi 39762). J. Appl. Phys. 45: No. 4, 1915-1917 (Apr 1974).

The experimentally observed magnetically induced dynamics of the anodic arc region of an argon arc discharge are presented for Lorentz and retrograde motion. The same externally applied conditions were employed for both modes of motion. The anodic arc region proceeds in the Lorentz direction through the formation of anode arc spots on the Lorentz side of the arc discharge. During retrograde motion, a new anodic arc region is created on the retrograde side of the original anodic arc region by a discharge initiating between the anodic and chathodic regions. The separation of the positive column and the original anodic arc region during retrograde motion results in an anodic arc spot where the original anodic arc region existed. (auth)

26567 SPACE RESOLVED X-RAY MEASUREMENTS ON LASER PRODUCED PLASMAS. Key, M. H.; Eidmann, K.; Dorn, C.; Sigel, R. (Max-Planck-Institut fuer Plasmaphysik, Garching; Muenchen (F. R. Germany)). Phys. Lett., A; 48: No. 2, 121-122(3 Jun 1974).

Soft X-ray emission from laser produced plasmas has been studied with 15 microns space resolution giving data on absolute density and density gradients near the critical density. (auth)

26568 INVERSION OF ABEL'S INTEGRAL EQUATION-APPLICATION TO PLASMA SPECTROSCOPY. Fleurier, C.; Chapelle, J. (Centre National de la Recherche Scientifique, 45-Orleans-la-Source (France). Center de Recherches sur la Physique des Hautes Temperatures). Comput. Phys. Commun.; 7: No. 4, 200-206(Apr 1974).

The radial distribution of the emission coefficient from the measured intensity distribution emitted by an extended source of radiation, particularly a plasma source, is determined. The source is assumed to be optically thin and axially symmetrical. This problem is solved by inverting Abel's integral equation. A smoothing procedure is made on the experimental curve in order to attenuate the random errors before computing the derivative. The integral is calculated analytically in a small interval on the right of the discontinuity point, the other part is estimated numerically. (auth)

26569 ESTIMATION OF THE PLASMA CHARACTERISTIC QUANTITIES FROM THE ELECTROMAGNETIC SIGNALS OBTAINED IN TOKAMAK EXPERIMENTS. Toi, K.; Takeda, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Nucl. Instrum. Methods; 118: No. 1, 299-305(1 Jun 1974).

A method of processing the data obtained from electromagnetic measurements in tokamak experiments is investigated. In the analysis of the digitized data it is necessary to smooth the data especially when numerical differentiation is required to process the time series consisting of the digitized data. The method of least squares is adopted as the smoothing method. The procedure to determine the most suitable degree of smoothing is described with a few illustrative examples. The energy confinement time of the JAERI tokamak (JFT-2) has been evaluated in accordance with the procedure. (auth)

26570 MASS SPECTROSCOPY OF THE PLASMA OF CW AND TEA CO_2-LASER DISCHARGES. Schoetzau, H. J.; Conti, F.; Gindrat, R.; Kneubuehl, F. K. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festkoerperphysik). Phys. Lett., A; 48: No. 3, 205-206(17 Jun 1974).

The composition of the plasmas in cw- and TEA-CO_2 laser discharges was analyzed with a quadrupole mass spectrometer. Small concentrations of discharge-generated nitrogrn oxides already known to be present in the cw-CO_2 laser plasmas, have also been found in the TEA-CO_2 laser plasmas. (auth)

Kinetics (General)

26571 (AD-773399) STABILIZATION AND CONTROL OF HIGH-TEMPERATURE PLASMAS. Final Report, 1 November 1966–30 June 1973. Corbin, J. C. Jr. (Aerospace Research Labs., Wright-Patterson AFB, Ohio (USA)). Oct 1973. 15p. (ARL-73-116). NTIS $3.00.

The results of research studies leading to the stabilization and control of plasma instabilities in a magnetic mirror device (ELMAX) of the Plasma Physics Research Laboratory during the period 1 November 1966 to 30 June 1973 are summarized. Results are categorized under plasma source development, diagnostic methods, instabilities, stabilization, and theory. A complete listing of all publications/presentations is included. Feedback and parametric suppression of drift-type instabilities, development of time-resolved diagnostic methods for determining exact phase relationships among key plasma parameters, and extension of collisional drift wave theory are a few of the accomplishments cited. (auth)

26572 (COM-774483) SPHERICAL IMPLOSION OF THICK LINERS WITH COMPRESSIBILITY AND PLASMA LOSS. Turchi, P. J. (Naval Research Lab., Washington, D. C. (USA)). Jan 1974. 46p. (NRL-MR-2711). NTIS $3.25.

Fusion reactors based on imploding liner flux compression can use the imploded liners surrounding the reacting plasma as a neutron-absorbing blanket and thermal reservoir. In this report, the final stages of liner-plasma compression are modelled in terms of the one-dimensional implosion of a thick, spherical shell. Spindle cusp plasma confinement is assumed, with plasma loss by particle efflux through the ring and point cusps. The liner material is treated as an inviscid, incompressible fluid. Compressibility effects are included in the liner motion, however, by correcting for energy loss to liner material compression. (auth)

26573 (EUR-CEA-FC-729) POPULATIONS OF EXCITED HYDROGEN AND HELIUM ATOMS IN PLASMAS IRRADIATED BY A LASER BEAM. Drawin, H. W.; Emard, F.; Dubreuil, B.; Chapelle, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jan 1974. 50p. Dep. NTIS (US Sales Only) $5.50.

The populations of excited hydrogen and helium atoms in nonlte plasmas were calculated for two different physical situations, namely (1) no external radiation field present, and (2) strong superposed radiation originating from a CO_2, ruby or argon ion laser. The radiation field intervenes in the collisional-radiative model via two new terms, i.e., photoionization and stimulated recombination induced by the laser radiation field. The solutions of the rate equations yield a lowering of the populations when a plasma is irradiated by a laser beam. The lowering is different for cold recombining and hot diffusion-dominated plasmas. At high radiation densities a saturation effect occurs, since the photoionization rate becomes equal to the rate of stimulated recombination. Measurements of the populations of excited H and He atoms in a glow discharge irradiated by a CO_2 laser beam of power density $10^5 W/cm^2$ are in broad agreement with the theoretical predictions. (FR)

26574 (IPP-3/13) A JOINT STATISTICAL COUNT OF FREE AND BOUND ELECTRON STATES. Klueber, O.; Wulff, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jun 1974. 19p. (In German). INIS.

With abstract in German and English.

A uniform count of all electron states, i.e. bound and free, is presented. The search for the entropy maximum then yields the equilibrium distribution. The latter is described by formulae from which one can derive the Boltzmann coefficient, Maxwell-Boltzmann velocity distribution function of free electrons and the Saha equation. (GE)

26575 IONIZATION ZONE IN A TWO-LENS ACCELERATOR. Abramov, V.A.; Zubkov, I.P.; Kislov, A.Y. Sov. Phys.—Tech. Phys. 18: No. 12, 1609-1612 (June 1974).

The ionization zone in a high—current "two—lens" accelerator is investigated with probes and by optical methods. The two methods yield consistent results. It is shown that the dimensions of the ionization zone are markedly reduced in comparison with those of an earlier model of the accelerator. (auth)

26576 PONDEROMOTIVE FORCE EXERTED ON A PLASMA BY AN INFRARED LASER BEAM. Marhic, M. E. Los Angeles; Univ. of California (1974). 132p. University Microfilms Order No. 74-18,786.

Thesis (Ph.D.).

The single-particle and continuum approaches to the ponderomotive force in an underdense plasma are presented and compared. The force density $(\omega_p^2/\omega^2)\nabla(\epsilon_0 E^2/2)$ tends to expel the plasma radially out of a focused laser beam, and in the presence of a strong magnetic field the motion is one-dimensional. Transient and steady-state responses of the plasma to the ponderomotive force are studied using a one-fluid model, with the force being exerted on the electrons, and the inertia being provided by the ions. The importance of the parameter $\alpha = \{(\omega_p^2/\omega^2)(\epsilon_0(E^2/2)]/2n_eKT\}$, ratio of the plasma oscillatory to thermal energy, becomes apparent. It is shown that large values of α can significantly modify the transient response of the plasma by either saturation or particle trapping in potential throughs. In order to check the theoretical predictions, an experiment is described in which a measurable plasma density drop will occur in the focal region of a powerful laser beam. A magnetically confined dc arc creates an argon plasma about 3 mm in diameter, with the parameters: I = 100 A, B = 5 kG, T = 1.4 eV, $n_e \approx 3 \times 10^{14}$ cm^{-3}. Thomson scattering measurements of the density are described. (Diss. Abstr. Int., B)

26577 MICROWAVE DISCHARGE IN ARGON. Belousov, E.V.; Bryukhovetskii, A.S.; Prokopov, A.V. (Institute of Radiophysics and Electronics, Ukrainaian Academy of Sciences, Khar'kov). Sov. Phys.—Tech. Phys. 19: No. 1, 53-56 (July 1974).

By simultaneously solving the Boltzmann kinetic equation and the energy balance equation we obtain the electron energy distribution function, the electron temperature, and other parameters of a microwave—discharge plasma in the skin layer. The kinetic equation takes account of the influence of the magnetic field, electron—electron collisions, and elastic and inelastic collisions. The experimental values of the electron density and gas temperature in a discharge excited in argon by a 3—cm band source are used for the numerical calculations. The results are compared with the experimental data. (auth)

26578 ORIGIN OF AFTERGLOW IN A PULSED ARGON DISCHARGE. Bertschinger, F.; Schmid, H.; Buttlar, H. v. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik). Z. Phys.; 268: No. 2, 129-132(Jun 1974). (In German).

3 figs.; 13 refs.

The spectrum of the delayed light radiation from a pulsed corona discharge in pure argon was investigated in cylindrical geometry. The band-like structure near 309 nm can be attributed to molecular transitions in the OH-radical. The weak bands at 337 nm and 357 nm originate from transitions in the N_2 molecule. The molecular states of OH and N_2 are excited by collisions of $^3P_2$-metastable argon atoms (formed in the gas discharge) with H_2O and N_2 molecules present as small impurities. The pressure dependence of the time constant (some 100 ωs) of the afterglow is discussed. (auth)

Kinetics (Experimental)

26579 DYE LASER INDUCED FLUORESCENCE OF PLASMAS AND ITS APPLICATION TO MEASUREMENT OF LOWER STATE DECAY RATES. Burgess, D. D.; Skinner, C. H. (Imperial Coll. of Science and Tech., London). J. Phys., B (London); 7: No. 9, L297-L301(21 Jun 1974).

A simple but powerful extension of fluorescence scattering methods for the measurement of decay rates is described together with results of an experiment on a helium plasma. The technique should allow measurements of A-values and excitation rates for vacuum UV transitions from observations of visible fluorescence, and reduce the need for short pulse lasers for decay rate measurements. (auth)

26580 ELECTRON ENERGY DISTRIBUTION AND ELECTRICAL CHARACTERISTICS OF THE POSITIVE COLUMN IN H_2 AND H_2+Cl_2. Zaitsev, V.V.; Maksimov, A.I.; Svettsov, V.I. (Ivanov Chemical Engineering Institute). Sov. Phys.—Tech. Phys. 19: No. 1, 57-59 (July 1974).

The spatial variation of the electron energy distribution, the plasma potential, and of the floating potential in a striated glow discharge in hydrogen and in a hydrogen—chlorine mixture is studied experimentally at a pressure of 0.258 mm Hg and a current of 15 mA in a tube 26 mm in diameter and 50 cm long. It is shown that the fraction of high—energy electrons in the distribution function increases at a chlorine concentration of 0.01—0.1%. The radial variation of the floating potential and the plasma potential points to the possible existence of negative ions in the presence of chlorine. (auth)

26581 DETERMINATION OF DIFFUSION VELOCITIES IN ARGON AND HELIUM PLASMAS. Pytlinski, J.T.; Jones, W.D.; Oleson, N.L.; Flynn, R.W. (Department of Physics, University of South Florida, Tampa, Florida 33620). J. Appl. Phys. 45: No. 9, 3809-3812 (Sept 1974).

Some results of the investigation of plasma diffusion velocity in collisionless argon plasma and collision—dominated helium plasma in the steady state are presented. The experiment was performed for argon pressures of 1.25×10^{-3}, 3.8×10^{-3}, and 8.0×10^{-3} Torr and for helium pressures of 2.4×10^{-2}, 3.3×10^{-2}, and 4.6×10^{-2} Torr. It is shown that in the hot—cathode—type steady—state discharge a plasma diffusion velocity obtained by using an ion acoustic wave technique represents only a sort of average value in the region of measurement and that actually it increases with radial distance. (auth)

26582 X-RAY STRUCTURE OF A PINCHED PLASMA IN A VACUUM SPARK. Welch, T.J.; Clothiaux, E.J. (Physics Department, Auburn University, Auburn, Alabama 36830). J. Appl. Phys. 45: No. 9, 3825-3827 (Sept 1974).

The size and shape of an x—ray source formed by a plasma pinch have been determined using time—integrated pinhole photography. Pinhole diameters as small as 4 μ have been used to image a source whose length is usually about one order of magnitude larger than this pinhole diameter. Such measurements should refine the density determination of the source and are essential to specifying a charged—particle acceleration mechanism in the pinch region. The x—ray images, visible streak photographs, and x—ray—source lifetime measurements suggest that the x—ray source may, as a whole, be moving as it emits. (auth)

Kinetics (Theoretical)

Refer also to abstracts 26618 and 27994.

26583 (AD-775448) SIMULATION OF A SIMPLE LORENTZ PLASMA WITH A RANDOM DISTRIBUTION OF INDUCTIVELY LOADED DIPOLES. Merkel, G. (Harry Diamond Labs., Washington, D. C. (USA)). Nov 1973. 45p. (HDL-TR-1637). NTIS $5.25.

The feasibility of simulating a simple Lorentz plasma with an artificial dielectric constructed from a random distribution of inductively loaded dipoles is investigated. Both the differences and similarities between the macroscopic electromagnetic properties of the artificial dielectric and Lorentz plasma are discussed. (auth)

26584 (IPP-6/125) PLASMA TRANSPORT EQUATIONS FOR HIGH FLOW VELOCITIES. Salat, A. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jun 1974. 53p. Dep. NTIS (US Sales Only) $5.75.

Collision terms for plasma transport equations are derived from the Fokker—Planck equation without the usual linearization in U = flow velocity/thermal velocity. A 13—moment ansatz for the distribution functions includes the linearized dependence of the collision terms on viscous pressure and heat flow in the transport equations for momentum, energy, viscous pressure and heat flow. The masses, densities, flow velocities and temperatures of the species are arbitrary. Simplified results for small mass ratio or equal masses are given. For moderate velocities the collision terms are expanded in powers of U. Some of the resulting lowest order terms are nonlinear. These usually neglected collision terms may be important for moderate U. (auth)

26585 LAGRANGIAN FORMULATION OF THE ONE-DIMENSIONAL VLASOV EQUATION. Lewak, G.J. (Department of Applied Physics and Information Science, University of California, San Diego, La Jolla, California 92037). Phys. Fluids 17: No. 4, 746-750 (Apr 1974).

A new formulation of the one-dimensional Vlasov equation is derived which is analogous to the Kalman-transformed cold-plasma equations. The equations are shown to yield nonsecular, nonlinear approximations to a source or boundary-value problem. It is suggested that the formulation may have other applications in nonlinear plasma theory. (auth)

26586 PHENOMENOLOGICAL DESCRIPTION OF A PLASMA BOUNDARY. Romanova, V.I. Sov. Phys.-Tech. Phys. 18: No. 11, 1443-1445 (May 1974).

The excitation of a plasma half-space at a finite temperature by the field of a plane electromagnetic wave is analyzed. At the plasma boundary the particle momentum distribution function obeys boundary conditions which correspond to return into the plasma of all electrons travelling to the boundary, with complete loss of the initial momentum at the boundary. A comparison is made with results for which the distribution function satisfies the Reuter-Sondheimer boundary conditions. (auth)

26587 COMPTON TRANSPORT CROSS SECTION FOR A HOT PLASMA. Cooper, G. E. (Univ. of California, Livermore). J. Quant. Spectrosc. Radiative Transfer; 14: No. 9, 887-897(Sep 1974).

The equation for diffusion transport of photons in a hot, Compton-scattering-dominated plasma is derived and a transport cross section is identified. Using a reasonable assumption for the frequency dependence of the flux, this relativistically-correct cross section is numerically evaluated for a set of photon energies and electron temperatures. A simple but accurate fit to the calculation is also presented. (auth)

26588 EQUILIBRIUM PROPERTIES AND SYMMETRIC WAVE PROPAGATION PROPERTIES OF RIGID ROTOR NONNEUTRAL PLASMAS. Theiss, A. J. College Park, MD; Univ. of Maryland (1973). 138p. University Microfilms Order No. 74-16,580.

Thesis (Ph.D.).

A cold constant density cylindrical column of electrons confined in a uniform magnetic field has equilibria characterized by a uniform rotation frequency given by $\dot{\theta}_0 = \Omega_c/2\,[1 \pm \sqrt{1-2\omega_p^2/\Omega_c^2}]$. Both fast and slow rotation mode equilibria have been generated and studied. The plasmas observed show the constant density and uniform, i.e., rigid, rotation frequencies associated with cold fluid theory. Fluid theory also predicts that the axisymmetric wave dispersion for such plasmas are characterized by two sets of waves having phase velocities much less than the speed of light. One of these waves is preferentially excited, studied and shown to behave in a way which agrees well with theory. Other waves are found which also are consistent with theory. (Diss. Abstr. Int.,B)

26589 KINETIC THEORY OF PLASMA. Dougherty, J. P. (Cambridge Univ., Eng.). pp 1-13 of Summer School on Plasma Physics and Solar Radioastronomy. Vol. 1. Mangeney, A. (ed.). Meudon, France; Observatoire de Paris-Meudon (1973).

From proceedings of the summer school on plasma physics and solar radioastronomy; Ile de Re, France (4 Sep 1972).

The Boltzmann equation is introduced. The kinetic theory of plasma oscillations and Landau damping are presented. The problems of waves in a hot magnetized plasma, and microinstabilities are analyzed. The relation between kinetic theory and MHD for plasmas is studied. (FR)

26590 RECOMBINATION IN AN EXPANDING PLASMA. Bykovskii, Y.A.; Degtyarenko, N.N.; Elesin, V.F.; Kondrashov, V.E.; Lovetskii, E.E.; Polyanichev, A.N.; Fetisov, V.S. (Moscow Engineering Physics Institute). Sov. Phys.-Tech. Phys. 19: No. 1, 43-48 (July 1974).

The problem expansion of a spherically symmetric plasma into vacuum is solved on the basis of the equations of hydrodynamics, taking account of recombination and ionization. A numerical solution is given for the expansion of a highly ionized hydrogen plasma. In addition to the rarefaction wave, a "recombination" wave propagates into the plasma. There is a significant "quenching" of the degree of ionization if the initial plasma radius is of the order of the characteristic recombination length. When the initial plasma dimensions are large, recombination during the expansion is essentially complete. The problem of recombination in an expanding carbon plasma is also solved on the basis of the hydrodynamic equations averaged over the volume. The densities of ions X(Z) having various charges Z are found as functions of the time. The asymptotic values of X(Z) are found as a function of the initial plasma dimensions. Ions of a given charge Z can be produced efficiently if the initial plasma dimension is of the order of the characteristic recombination length for ions with charge Z. (auth)

26591 REPLY TO COMMENTS BY R. J. MASON. Clark, R.W.; Denavit, J.; Papadopoulos, K. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Fluids 17: No. 5, 1052-1052 (May 1974).

We reply to Mason's comments about our paper concerning references and the maximum counter-streaming Mach number. (AIP)

26592 COMMENTS ON "LAMINAR INTERACTIONS IN HIGH MACH NUMBER PLASMA FLOWS". Mason, R.J. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Fluids 17: No. 5, 1051-1051 (May 1974).

We point out that the paper by Clark et al. does not mention several recent references, particularly with regard to cross-field shocks. (AIP)

26593 ROTATION OF A TOROIDALLY CONFINED, COLLISONAL PLASMA. Hazeltine, R.D. (Center for Plasma Physics and Thermonuclear Research, University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 17: No. 5, 961-968 (May 1974).

Plasma rotation in the collisional regime is considered from the viewpoint of the drift-kinetic equation, using orderings which have become standard in neoclassical transport theory. Kinetic arguments require a unique relation between the ion parallel flow U and the radial gradients of density, temperature, and electrostatic potential; this relation is derived and compared to similar relations for collisionless regimes. The off-diagonal stress tensor component, which governs the time evolution of U is also calculated. This component does not resemble a viscous stress, and dominates classical viscosity by roughly the usual Pfirsch-Schlüter factor. (auth)

26594 FOKKER-PLANCK EQUATION FOR A PLASMA IN A MAGNETIC FIELD. Montgomery, D.; Turner, L. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706); Joyce, G. Phys. Fluids 17: No. 5, 954-960 (May 1974).

A convergent Fokker-Planck equation is derived for an electron plasma in a strong dc magnetic field. Conservation laws and an H theorem are proved. The equation is manipulated into a form in which it is straightforward to evalute magnetic-field-dependent relaxation times in terms of a series of modified Bessel functions. (auth)

26595 BIFURCATION OF ELLIPTIC EQUILIBRIUM. Strauss, H.R. (Center for Plasma Physics and Thermonuclear Research, University of Texas at Austin, Austin, Texas 78712). Phys. Fluids 17: No. 5, 1040-1041 (May 1974).

The magnetohydrodynamic equilibrium of an elliptical, cylindrical plasma, with uniform current density, is not uniquely determined by the boundary conditions. (auth)

26596 TRANSPORT IN AXISYMMETRIC PLASMAS. Bernstein, I.B. (Lawrence Livermore Laboratory, University of Califonia, Livermore, California 94550). Phys. Fluids 17: No. 3, 547-558 (Mar 1974).

The general case of transport in axisymmetric fully ionized quasineutral plasmas is formulated for systems immersed in a strong magnetic field and close to local kinetic equilibrium. The particle density and temperature for each species, which depend on position only via the magnetic streamfunction, obey a closed system of transport equations involving coefficients which can be optimally computed via minimax variational principles. The electric field is eliminated from the transport equations, apart from the electrostatic potential which is obtained from a rate equation, as is the toroidal magnetic field. The magnetic streamfunction is determined by an elliptic boundary value problem. The theory goes over to previous work in the limit where the frequency associated with the guiding center motion of a representative particle in the absence of collisions is much greater than the collision frequency, and vice versa. (auth)

26597 VARIATION OF THE MAGNETIC MOMENT IN NONNEUTRAL ELECTRON PLASMAS. Kapetanakos, C.A.; Striffler, C.D. (Naval Research Laboratory, Washington, D. C. 20375). Phys. Fluids 17: No. 3, 657-659 (Mar 1974).

Exact and approximate expressions are obtained for the magnetic moment of a charged particle, under conditions pertinent to nonneutral electron plasma experiments. (auth)

Production

Refer also to abstract 26703.

26598 (AD-774089) INVESTIGATION OF EARLY DISTURBANCES FOUND IN ASSOCIATION WITH LASER-PRODUCED PLASMAS. Brooks, K. M. Sr. (Naval Postgraduate School, Monterey, Calif. (USA)). Dec 1973. 126p. NTIS $9.25.

Thesis.

A plasma was produced by the interaction of 300 MW, 25 nsec, Nd laser pulse with an aluminum target. The resulting plasma expanded into an ambient background of 0.000025 torr and was analyzed using floating double probes, magnetic probes, and a

quartz pressure probe. An early disturbance was noted before arrival of the main plasma. Further experiments separate this early signal into photoelectric response and two fast plasma pulses traveling with constant speeds of 1.1×10^8 and 5.9×10^7 cm/sec. (auth)

26599 (AD-775099) INVESTIGATION OF THE PRODUCTION OF HIGH DENSITY UNIFORM PLASMAS. Patrick, R.; Douglas-Hamilton, D. (Avco-Everett Research Lab., Everett, Mass. (USA)). Jan 1974. Contract F44620-70-C-0023. 46p. (AFOSR-TR-74-0194). NTIS $5.50.

A stable high-pressure electric discharge is produced using an electron beam to ionize the gas. The attachment instability in the discharge, discovered under this program, has been investigated in the gas mixtures ($He:CO_2:H_2O$) = (74:0:2), (9:1:0), (1:1:0) (mole fraction) and a theory predicting the instability has been derived. Experimental measurements of the discharge parameters for instability onset agree well with theoretical predictions. It appears that the onset of discharge arcing may be associated with this phenomenon, and theoretical understanding of it is expected to be of considerable importance in electric discharge gas laser systems. (auth)

26600 (SLA-74-5388) INTERACTION OF SUPER-PINCHED RELATIVISTIC ELECTRON BEAMS WITH DENSE TARGETS. Toepfer, A. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 26p. (CONF-740659-1). Dep. NTIS $4.50.

From Gordon research conference; Santa Barbara, California, USA (10 Jun 1974).

The experimental approach to the study of energy deposition by super-pinched electron beams in solid targets was to develop a reproducible pinched beam in which the spatial and temporal variation of current density at the anode plane is known. Experiments and theoretical modeling of the coupling problem indicate that witness plate damage can be correlated with total pinch energy. Rear surface motion of the target is a sensitive function of the total beam energy only for targets whose thickness is comparable to the deposition length of beam energy. Holographic interferometry of front surface blowoff indicates motion characteristic of plasma expansion into a vacuum. There is only a weak interaction of the expanding plasma with the self magnetic field of the electron beam. There is no indication that the blowoff plasma decouples the electron beam energy from the target. (auth)

26601 COLLISIONAL GENERATION OF PRECURSOR IONS BY LASER-PRODUCED PLASMA EXPANDING IN A GAS. Goforth, R.R.; Koopman, D.W. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Maryland 20742). Phys. Fluids 17: No. 4, 698-705 (Apr 1974).

A fast ion precursor is observed to propagate ahead of a laser-produced plasma expanding into a partially ionized background gas. The ions are identified to be of the background species, and their absolute energy distribution has been measured. Comparison of the data with detailed models suggests that the precursor ions arise from violent charge-transfer collisions between laser-target ions and background neutrals. (auth)

26602 LASER-INDUCED INSTABILITIES IN HOMOGENEOUS PLASMAS. Jorna, S. (KMS Fusion, Inc., Ann Arbor, Michigan). Phys. Fluids 17: No. 4, 765-777 (Apr 1974).

A linearized theory is presented for the dominant instabilities in a laser-driven homogeneous plasma. The distinction between convective and absolute instabilities, and their effect on thresholds in finite plasmas, is especially emphasized. Thus, it is found that the effective thresholds for stimulated Brillouin and Raman scattering are higher than those generally quoted. The analysis is further extended to two dimensions, and it is shown that stimulated Brillouin scattering is primarily excited in the backward direction. The broader backscattering profile for stimulated Raman scattering exhibits a cutoff angle approaching 90° near a "critical" surface at one-fourth the critical density. At this density a strong instability is predicted corresponding to the excitation of Langmuir waves. (auth)

26603 COMPARISON OF RADIATION FROM LASER-PRODUCED AND DC-HEATED PLASMAS IN XENON. Silfvast, W.T.; Wood, O.R. II. (Bell Telephone Laboratories, Holmdel, New Jersey 07733). Appl. Phys. Lett. 25: No. 5, 274-277 (1 Sept 1974).

The spectral radiance from a cylindrically shaped laser-produced plasma in the ultraviolet region (200-300 nm) is shown to be 2-3 times greater than that produced by a xenon flashlamp of comparable size and input energy. The experimental results suggest several advantages of laser-produced plasmas as sources for the optical pumping of lasers. (auth)

26604 EXPERIMENTAL EVIDENCE FOR POPULATION INVERSION IN C^{5+} IN EXPANDING LASER-PRODUCED PLASMA. Irons, F. E. (Australian National Univ., Canberra); Peacock, N. J. J. Phys., B (London); 7: No. 9, 1109-1112(21 Jun 1974).

In the freely-expanding and recombining plasma produced by target irradiation with a high-powered laser the excited states below the thermal limit may develop an inverted population distribution. This situation is experimentally confirmed from intensity measurements of the Lyman line series of C^{5+} ions from a polyethylene target. The density of the inverted populations is however too small to observe stimulated emission. (auth)

26605 STRIATED JETS DUE TO NONLINEAR PONDEROMOTIVE FORCES IN LASER PRODUCED PLASMAS AT OBLIQUELY INCIDENT LIGHT. Hora, H. (Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14627). Phys. Fluids 17: No. 5, 939-947 (May 1974).

An analysis is made of one of the expected nonlinear and anomalous mechanisms and instabilities in the corona of a laser irradiated plasma. As is well known, nonlinear ponderomotive forces generate a net acceleration of the plasma toward lower densities. It is demonstrated that the same forces at oblique incidence of the radiation, can cause a net motion perpendicular to the well-known forces along the density gradient: The standing wave generated that is split into zones (slabs) of the thickness of a quarter of a wave length, where the plasma is moving in the plane of incidence parallel and antiparallel to the slabs. This striated motion can also occur in an underdense plasma, while for the net acceleration toward lower density the strong change of the refractive index near the cutoff density is necessary. The striated parallel and antiparallel motion of the slabs is limited by the mean free path, by the velocity toward lower density and is determined by the condition of laminar and turbulent motion. The time constants on the order of picoseconds and the nonlinear absorption due to the generation of this striated motion are evaluated. Laser intensities exceeding 10^{13} W/cm^2 incident at angles of 25° should build up striated jets with ion energies of a few keV. (auth)

Stability

Refer also to abstracts 26602, 26659, and 26669.

26606 NONLINEAR THEORY OF THE COLLISIONAL DRIFT-WAVE INSTABILITY. Monticello, D.A.; Simon, A. (Department of Physics, University of Rochester, Rochester, New York 14627). Phys. Fluids 17: No. 4, 791-802 (Apr 1974).

Experiments have shown the existence of a steadily oscillating drift mode above a critical magnetic field, B_c, in fully ionized Q machines. The amplitude and frequency shift of this mode are calculated as a function of $\Delta = (B-B_c)/B_c$ for small Δ. The self-consistent analysis includes temperature variation and shows that non-linear saturation is due to flattening of the density gradient by zero-frequency harmonic generation. The results are compared with experiment and show good agreement. (auth)

26607 HYDROMAGNETIC STABILITY OF A CURRENT-CARRYING PINCH WITH NONCIRCULAR CROSS SECTION. Laval, G.; Pellat, R. (Centre de Physique Théorique de l'Ecole Polytechnique, Equipe de Recherche Associée au Centre National de la Recherche Scientifique, 75230 Paris, France); Soule, J.S. Phys. Fluids 17: No. 4, 835-845 (Apr 1974).

The hydrodynamic stability of a free-boundary pinch with noncircular cross section is investigated. The analysis is restricted to nonflute modes. The stability conditions for a pinch with elliptical cross section and flat current density are obtained. For arbitrary shapes and current profiles, an asymptotic stability criterion is given for kink and tearing modes of large azimuthal wavenumbers. (auth)

26608 LARGE AMPLITUDE STEADY-STATE HARMONIC CYCLOTRON WAVES. Aamodt, R.E. (Department of Astro-Geophysics, University of Colorado, Boulder, Colorado 80302). Phys. Fluids 17: No. 4, 803-809 (Apr 1974).

The spatial dependence of an electron plasma-harmonic ion cyclotron amplifying wave is derived for a steady-state loss-cone simulated system. Amplitude saturation is accomplished when the ion field energy density is balanced by the electron field energy density. For low-density systems this implies saturation amplitudes much less than the available free ion energy, while for high densities, essentially all of the initial free energy goes into the field. Wave damping finally occurs over long distances because nonlinearities cause ion resonance with the parallel wave motion, and the induced acceleration heats the ions along the direction of the external magnetic field. (auth)

26609 PARAMETRIC INSTABILITIES OF ELECTROMAGNETIC WAVES IN PLASMAS. Drake, J.F.; Kaw, P.K.; Lee, Y.C.; Schmidt, G. (Department of Physics, University of California at Los Angeles, California 90024); Liu, C.S.; Rosenbluth, M.N. Phys. Fluids 17: No. 4, 778-785 (Apr 1974).

A simple formalism for the parametric decay of an intense, coherent electromagnetic wave into an electrostatic wave and scattered electromagnetic waves in a homogeneous plasma is developed. Various instabilities including Brillouin and Raman scattering, Compton scattering, filamentational and modulational instabilities are derived and discussed in a systematic manner. Growth rates as a function of the incident pump power are shown. (auth)

26610 PARAMETRIC INSTABILITY THRESHOLDS AND THEIR CONTROL. Thomson, J.J.; Kruer, W.L.; Bodner, S.E. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550); DeGroot, J.S. Phys. Fluids 17: No. 4, 849-851 (Apr 1974).

It is shown that the "swelling" of the laser electric field must be included in threshold estimates for the electrostatic instabilities excited by a laser near the critical density. Random amplitude modulation of the laser is found to lead to an increased instability threshold. (auth)

26611 CONTRIBUTION TO SIDEBAND INSTABILITY THEORY. Bussac, M.N.; Mendonça, I.; Pellat, R.; Roux, A. (Centre de Physique Théorique de l'Ecole Polytechnique, 75230 Paris Cedex 05, France). Phys. Rev. Lett. 33: No. 6, 349-351 (5 Aug 1974).

The O'Neil trapping regime is known to take place only after a finite damping of the main wave. As a consequence of that finite damping, one obtains a beam–type distribution function for the detrapped particles. By including in the stability analysis this detailed distribution function, we give a new interpretation of the sideband generation. (auth)

26612 TRAPPED–PARTICLE STABILIZATION OF LOCALIZED INTERCHANGE MODES IN AXISYMMETRIC TOROIDAL PLASMAS. Connor, J.W.; Hastie, R.J. (United Kingdom Atomic Energy Authority Culham Laboratory, Abingdon, Berkshire, United Kingdom). Phys. Rev. Lett. 33: No. 4, 202-205 (22 July 1974).

A stability criterion for localized modes in an axisymmetric toroidal plasma is derived from the kinetic energy principle, taking account of trapped particles. This criterion predicts greater stability than the Mercier criterion. (auth)

26613 MOTION OF A CHARGED PARTICLE IN THE FIELD OF A FLUTE INSTABILITY. Kukushkin, A.S. Sov. Phys.–Tech. Phys. 18: No. 11, 1416-1417 (May 1974).

An estimate of the maximum value of the amplitude of flute instabilities in a short trap which does not give rise to serious loss is obtained. (auth)

26614 ION PLASMA OSCILLATIONS IN AN "ION BEAM" PLASMA. Gabovich, M.D.; Soloshenko, I.A.; Goncharov, A.A. (Physics Institute, Academy of Sciences of the Ukrainian SSR, Kiev). Sov. Phys.–Tech. Phys. 18: No. 11, 1450-1452 (May 1974).

The interaction of an ion beam with a plasma produced by ionization of the residual gas is investigated experimentally when the beam velocity is equal to or greater than the thermal velocity of the plasma electrons. It is shown that the beam excites longitudinal electron plasma oscillations and ion plasma oscillations that propagate almost perpendicularly to the beam direction. The linear and nonlinear stages of these oscillations are investigated. It is shown that the experimentally measured growth rates coincide with the calculations, and that the exponential growth of the oscillations is limited as a result of the trapping of particles in the potential well of the wave. The possible influence of the oscillations on the propagation of ion beams is discussed. (auth)

26615 NONLINEAR STATISTICAL THEORY FOR CONDENSATION OF LANGMUIR PLASMONS. I. NONLINEAR PLASMON–CONDENSATE INTERACTIONS. Khakimov, F.K.; Tsytovich, V.N. (V. I. Lenin Tadzhik State University, Dushanbe). Sov. Phys.–Tech. Phys. 18: No. 12, 1563-1568 (June 1974).

The nonlinear changes in the direction and intensity of the spectral composition of plasma waves resulting from the formation of a condensate (accumulation of plasmons at high phase velocities in the turbulent regime) are analyzed. (auth)

26616 NONMONOENERGETIC RELATIVISTIC ELECTRON BEAM IN A BOUNDED COLLISIONAL PLASMA. Grigor'ev, V.P.; Shulaev, N.S. (Scientific Research Institute of Nuclear Physics, Electronics, and Automation, Kirov Tomsk Polytechnic Institute). Sov. Phys.–Tech. Phys. 19: No. 1, 20-21 (July 1974).

The interaction between low–density relativistic electron beam and a spatially bounded magnetoactive plasma is analyzed. The longitudinal electromagnetic waves excited by the nonmonoenergetic beam are examined allowing for collisions between plasma electrons and heavy particles (neutral molecules or ions); the maximum growth rates are computed as functions of the system parameters. It is shown that an energy spread in the beam electrons results in a stabilization of hydrodynamic instability and the appearance of threshold currents. (auth)

26617 STABILIZATION OF MHD INSTABILITIES BY A HIGH–FREQUENCY CURRENT IN A STRAIGHT SYSTEM. Fedyakova, V.P. Sov. Phys.–Tech. Phys. 19: No. 1, 16-19 (July 1974).

We describe an experimental study of the stabilizing action of a hf current which passes through an unstable (Kruskal–Shafranov) plasma with a quasistationary current in a straight system. The amplitude of the hf current needed to stabilize the plasma is smaller than that derived from the theory of dynamic stabilization and the range of stabilization for longitudinal field values is broader. The more effective stabilization is connected with the production of turbulence by the hf current in the plasma skin layer and the creation of a positive gas–kinetic pressure gradient inside the plasma. (auth)

26618 IONIZATION DISCONTINUITY IN LARGE–AMPLITUDE STRIATIONS. Nedospasov, A.V.; Petrov, V.G. (Institute of High Temperatures, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Tech. Phys. 19: No. 1, 31-34 (July 1974).

The potential discontinuity in large–amplitude striations in the positive column in an inert gas is investigated. With energy balance throughout the striation taken into account, a common solution is found for the electron kinetic equation, the continuity equation, and the equation of motion for ions. The potential profile and the electron distribution are found. (auth)

26619 PARAMETRIC PLASMA INSTABILITIES EXCITED BY THE SUDDEN APPLICATION OF AN ELECTRIC FIELD. Kitsenko, A.B.; Stepanov, K.N. (Technical Physics Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Tech. Phys. 19: No. 1, 127-128 (July 1974).

The present work considers the parametric instability in a plasma which occurs on the sudden application of an external electric field $E(t) = E_0 \sin \omega_0 t$. The unperturbed distribution function for particles of species α is a doubly periodic function of time with periods $2\pi/\omega_0$ and $2\pi/\omega_\alpha$ (ω_α is the cyclotron frequency for particles of species α). A dispersion equation is obtained for oscillations at a frequency and growth rate much smaller than the pump frequency ω_0. The equation is analyzed for the case of a cold plasma in which the oscillatory velocity of the electrons in the field E is greater than the thermal velocity. It is shown that parametric instabilities are most strongly developed under the resonance conditions $\omega_k \simeq k_\parallel \dot{u}^{(\alpha)} + m_0\omega_0 + r_0\omega_{B\alpha}$ (m_0, $r_0 = 0, \pm 1, \pm 2, \ldots$ $\dot{u}^{(\alpha)}$ is the average electron drift speed along the magnetic field and ω_k are the natural frequencies of the longitudinal electron oscillations in the plasma). (auth)

26620 EFFECT OF CATHODE EMISSION ON THE THRESHOLD FOR STRIATIONS. Vorob'eva, N.A.; Kagan, Y.M.; Milenin, V.M.; Muradov, A.K. (A. A. Zhdanov Leningrad State University). Sov. Phys.–Tech. Phys. 19: No. 1, 117-118 (July 1974).

Experimental results showing the influence of cathode emission on the threshold for striations in a helium discharge are reported. Striations of two types can arise, depending on whether the cathode operates in the saturation regime. (auth)

26621 COLLECTIVE CONTRIBUTIONS TO THE ELECTRIC MICROFIELD DISTRIBUTION IN A TURBULENT PLASMA. Spatschek, K. (Institut für Theoretische Physik, Ruhr–Universität Bochum, D–463 Bochum, Germany). Phys. Fluids 17: No. 5, 969-972 (May 1974).

The electric microfield distribution for weakly turbulent electron–ion systems is calculated using an individual–collective approach. The possibility of separation into collective ion, collective electron, and individual contributions due to electrons and ions is discussed. Analytical expressions for the collective electron and the collective ion microfield distribution are presented in terms of the turbulent spectrum. The results for the total distribution in the case of ion–sound turbulence show significant deviations compared with those of plasmas in thermodynamic equilibrium. (auth)

26622 REPLY TO COMMENTS BY KAYA IMRE AND ERCUMENT OZIZMIR. Fried, B.D.; Wong, A.Y. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Fluids 17: No. 5, 1048-1048 (May 1974).

We express the view that the calculations of Imre and Ozizmir are not relevant to the physical situation under consideration. (AIP)

26623 ELECTRON SCATTERING BY ENHANCED FLUCTUATIONS IN QUIESCENT MIRROR MACHINES. Aamodt, R.E.; Baldwin, D.E. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 17: No. 5, 1044-1045 (May 1974).

Enhanced electron scattering induced by the Rosenbluth–Post convective loss–cone instability could reduce electron Landau damping and produce a highly unstable configuration. The effect is calculated and shown to be unimportant for fusion devices. (auth)

26624 ENHANCEMENT OF PLASMA DIRECT CURRENTS BY INTENSE ALTERNATING CURRENT FIELDS. Lin, A.T.; Dawson, J.M. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Fluids 17: No. 5, 987-994 (May 1974).

Instabilities in a plasma containing electrons drifting relative to the ions and subjected to an intense ac electric field of frequency ω are investigated. The beat disturbance produced by the interaction of the driving field and ion density fluctuations of wavenumber k_i accelerates electrons of velocity ω/k_i. If this is larger than the electron drift velocity, the acceleration enhances the current, while the recoil momentum imparted to the ion fluctuation can cause it to grow. The process has been simulated on a one-dimensional plasma model and it was found that the small amplitude growth is in agreement with a theory which is a minor modification of that for the anomalous high-frequency resistivity. Nonlinear effects ultimately saturate the growth of the instability and the current enhancement, and some discussion of these is given. (auth)

26625 PARAMETRIC INSTABILITY ARISING IN INHOMOGENEOUS PLASMAS. Whitfield, D.W.A. (Physics Department, University of Saskatchewan, Saskatoon, Saskatchewan, Canada). Phys. Fluids 17: No. 5, 995-1000 (May 1974).

A new, electrostatic, one-dimensional plasma instability is described. It arises when an external electric field is applied to a cold plasma in which both species have initial density perturbations. Both computer simulations and fluid calculations have revealed the instability, which, for sufficiently large perturbations, has a growth rate greater than the two-stream instability. (auth)

26626 TURBULENT QUENCHING OF THE DRIFT-DISSIPATIVE MODE IN A Q MACHINE: THEORY AND EXPERIMENT. Thomson, J.J.; Benford, G.; Rynn, N.; Williamson, W.S. (Department of Physics, University of California at Irvine, Irvine, California 92664). Phys. Fluids 17: No. 5, 1008-1013 (May 1974).

Current-generated broadband turbulence can appear to individual particles as a diffusive damping, leading to saturation of low-frequency modes in steady-state experiments. Mode saturation occurs when the linear growth $\gamma = k_\perp^2 D_\perp$, the diffusive damping. As long as mode frequency $\omega > k_\perp^2 D_\perp$, the mode is well defined. When $k_\perp^2 D_\perp > \omega$, the mode loses meaning and should disappear. The turbulent damping $k_\perp^2 D_\perp$ is interpreted as an upper bound on the linewidth of the wave. As current increases, frequency falls and linewidth increases. The mode is quenched when damping exceeds the mode frequency. Agreement with experiment is good. (auth)

26627 COMMENTS ON "Stability LIMITS FOR LONGITUDINAL WAVES IN ION BEAM-PLASMA INTERACTIONS". Imre, K.; Özizmir, E. (Richmond College, The City University of New York, Staten Island, New York 10301). Phys. Fluids 17: No. 5, 1046-1047 (May 1974).

It is shown that electron dynamics significantly alters the stability limits of the ion-acoustic waves in a plasma-ion beam system even when phase velocity is much smaller than the electron thermal velocity. (auth)

26628 LONG-WAVELENGTH KINK INSTABILITIES IN LOW-PRESSURE, UNIFORM AXIAL CURRENT, CYLINDRICAL PLASMAS WITH ELLIPTIC CROSS SECTIONS. Dewar, R.L.; Grimm, R.C.; Johnson, J.L.; Frieman, E.A.; Greene, J.M.; Rutherford, P.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 17: No. 5, 930-938 (May 1974).

The magnetohydrodynamic stability of a straight plasma column with elliptic cross section, carrying a uniform axial current, is investigated by extremizing the Lagrangian of the system using a natural coordinate system based on the magnetic field lines. Stability criteria are derived and growth rates are obtained analytically for systems with a uniform mass density inside the plasma. It is shown that the coupling between kink modes and Alfvén waves produced by noncircularity is a destabilizing effect. A technique for solving the problem numerically is also discussed and used to demonstrate the effect of a spatially varying plasma density on the growth rate. (auth)

26629 NEW APPROACH TO MAGNETOHYDRODYNAMIC STABILITY: I. A PRACTICAL STABILITY CONCEPT. Goedbloed, J.P.; Sakanaka, A.H. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). Phys. Fluids 17: No. 5, 908-918 (May 1974).

An equilibrium is called σ stable if growth faster than $\exp(\sigma t)$ does not occur. On the basis of this definition a modified energy principle is obtained by means of which the stability of plasma confinement systems can be tested for times of thermonuclear interest, instead of the infinitely long times which are pertinent to the usual stability analysis. The theory is applied to the diffuse linear pinch, a theorem for σ stability is derived, and the connection with the normal-mode analysis is shown to be given with the Sturmian property, which holds for the unstable side of the spectrum, whereas the stable side consists of Sturmian and anti-Sturmian point spectra separated by continuous spectra. Growth rates and eigenfunctions of Suydam modes are numerically calculated, and it is shown that violation of Suydam's criterion in the high and intermediate shear case leads to nonlocalized rapidly growing m=1 modes. Consequently, this criterion obtains new relevance in the σ-stability analysis for this regime. (auth)

26630 NEW APPROACH TO MAGNETOHYDRODYNAMIC STABILITY: II. SIGMA-STABLE DIFFUSE PINCH CONFIGURATIONS. Sakanaka, P.H.; Goedbloed, J.P. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). Phys. Fluids 17: No. 5, 919-929 (May 1974).

On the basis of the theory of σ stability, a classification of high-shear σ-stable diffuse pinch configurations is obtained by numerical solution of the Euler equation corresponding to the modified energy principle. Toroidal effects are introduced by putting a lower bound on the magnitude of the poloidal field in order to assure toroidal equilibrium and by deriving and employing the proper generalization of the Kruskal-Shafranov limit for m=1 unstable configurations. The classification of high-shear σ-stable configurations consists of five different types, viz.,tokamak, B_θ-reversed pinch, screw pinch, combined pinch, B_z-reversed pinch. Among the significant new results are: complete stability of some of the tokamak configurations for β up to 4%, a stable high-β (30%) B_θ-reversed pinch configuration that has not been investigated before, a stable diffuse screw pinch with $\beta = 30\%$ when currents are allowed to flow at the wall and with $\beta = 8\%$ with vanishing current at the wall, the possibility of containing diffuse high-β m=1 stable plasmas without B_z-field reversal or pressure minimum on axis. Here, σ stability refers to times needed for fusion. (auth)

26631 KINK INSTABILITIES IN ARBITRARY CROSS-SECTION PLASMAS. Marder, B.M. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Fluids 17: No. 3, 634-639 (Mar 1974).

A numerical method is presented to study the thin skin magnetohydrodynamic stability to kink modes of arbitrary cross section two-dimensional plasmas. Only long wavelength perturbations are considered but no other restrictions are assumed. Laplace's equation is solved for the perturbed fields by using a variation of Green's third formula. (auth)

26632 PHASE-ANALYSIS STUDIES OF THE FREQUENCY SPECTRUM OF OSCILLATIONS EXCITED IN THE PLASMA-BEAM DISCHARGE. Zeidlits, V. P.; Berezin, A. K. (Kharkov Physico-Tech. Inst.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 3, 353-358(Mar 1974). (In Russian).

The method based on frequency spectra used to study waves in an excited plasma does not permit simultaneous determination of the type of modulation that arises as a result of a different type of instability in the plasma. A method is described which can be used to separate the frequency and the phase modulation for an index of modulation ≥ 1. The separation is made from an oscillograph record of the process. The method is based on studying the behavior of the complete phase and the instantaneous frequency of waves excited in the plasma beam discharge. Phase modulation is observed in this discharge under definite conditions. (tr-auth)

26633 TRAPPED ION INSTABILITY IN TWO COMPONENT TORUS. Ohkawa, T.; Bhadra, D. K. (General Atomic Company, San Diego, California, USA). Phys. Lett., A; 48: No. 2, 140(3 Jun 1974).

The enhanced diffusion rate due to the trapped ion instability for a two component toroidal plasma is estimated. The energy confinement time is substantially reduced for the cases where the energy density of the hot component is comparable to that of the background plasma. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstract 26535.

26634 (AD-773937) FUSION PLASMA CONVERSION. Summary Progress Report, 1 Apr 1972-31 March 1973. Cowan, C. L. (Catholic Univ. of America, Washington, D. C. (USA)). 31 Mar 1973. Contract N00014-67-A-0377-0015. 10p. NTIS $3.00.

The ultimate objective of the research effort being carried on around the world is the achievement of a useful level of power output from a thermonuclear plasma. A new scheme for a fusion device was designed. This design, beginning with the simple desire to eliminate the need for coping with plasma instabilities in an essentially static, hot compressed plasma, led to the concept of dynamic containment. In this scheme, the plasma is contained in a continuously maintained magnetic field generated by three alternating fields. Heating is accomplished through a series

of successive shocks combined with ohmic heating by plasma currents. Such a cyclic device would be continuously running, meeting the Lawson criterion over a number of cycles, on the average. (GRA)

26635 (BMI-1930) EVALUATION OF ELECTRICAL INSULATORS FOR FUSION REACTORS. Bauer, A. A.; Bates, J. L. (Battelle Columbus Labs., Ohio (USA)). 31 Jul 1974. Contract W-7405-eng-92. 228p. Dep. NTIS $14.50.

A literature survey was conducted to assess electrical, thermal, irradiation, compatibility, and fabrication data available concerning electrical insulators that might be considered for application in controlled thermonuclear reactors. Prior reviews were used wherever possible and recently published information was introduced for updating purposes. Prior to undertaking the survey, insulator requirements for magnetically confined fusion reactors were identified. On the bases of these requirements, particularly for the first wall of the theta-pinch reactor, specific insulator materials were selected for review, and those materials with obvious limitations for use in the anticipated operating environment were eliminated. The materials are reviewed categorically, first for oxides and then nitrides. Where possible, preferred values of thermal and electrical conductivity are presented. Appendixes provide general overviews of coating technology and compatibility for insulators systems. (auth)

26636 (CONF-730480-) MINUTES OF THE CTR ELECTRICAL INSULATOR R. AND D. MEETING, BROOKHAVEN NATIONAL LABORATORY, APRIL 5–6, 1973. Goland, A. N. (Brookhaven National Lab., Upton, N. Y. (USA)). 18 May 1973. 24p. Dep. NTIS $4.25.

Insulator requirements for the theta-pinch reactor are discussed. Conditions expected at the insulator are given in tabular form for the Los Alamos SFX and RTPR experiments. Brief status reports are given of work at LASL and BNL, A.I., Georgia Tech, PNL, Battelle, and LLL. (MOW)

26637 (LA-5673-MS) TRANSFORMER FOR INJECTION EXPERIMENTS. Siemon, R. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 7p. Dep. NTIS $4.00.

An air-core transformer was designed to provide a slow rising field in a single-turn coil. The primary, driven by available 10-kV capacitors, carries a relatively small current (~200 kA), while the secondary carries a large current (over 4 MA). Although the efficiency is modest (about 20%), the transformer gives the proper rise time and the small primary current requires few switches and cables in the capacitor bank. (auth)

26638 (ORO-4514-1) PRODUCTION AND ANALYSIS OF THERMONUCLEAR PLASMAS IN HIGH BETA DEVICES. Progress Report. Griem, H. R. (Maryland Univ., Baltimore (USA)). 1974. Contract AT(40-1)-4514. 7p. Dep. NTIS $4.00.

The general goal of this envisaged five year research program is to investigate the compatibility of fast theta pinch heating methods and confinement. The present progress report and renewal proposal were written after seven months had gone by of this five year period. Definition, design and ordering of all major components for a circular cross section toroidal experiment have taken place. A realistic schedule is given for the construction of this experiment, and for the preparation of the various diagnostics, several of which have been or are being applied to the linear theta pinch. Considerable attention is also given to the noncircular version(s) of the toroidal theta pinch experiment. To test the basic concept at interesting β-values and otherwise suitable parameters, a flexible pilot experiment was constructed which should explore the field before one has to decide on the configuration for the big belt pinch. (auth)

26639 (PR-27) WILLS PLASMA PHYSICS DEPARTMENT TWENTY-SEVENTH 6-MONTHLY PROGRESS REPORT, 1 JANUARY–30 JUNE 1974. (Sydney Univ. (Australia). School of Physics). 1974. 10p. Dep. NTIS (US Sales Only) $4.00.

Research work is proceeding in topics such as plasma sources, hydromagnetic shock waves, rotating plasmas and magnetohydrodynamics. Other topics include laser inferferometry and plasma controlled lasers. (AT)

26640 (UCID-15526) PRELIMINARY INVESTIGATIONS OF A HARD TUBE MODULATOR FOR ASTRON. Winter, S. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Aug 1969. 10p. Dep. NTIS $4.00.

A design study of a hard tube modulator system was made to determine the technical feasibility, and to obtain an estimate of the cost, of a high repetition rate accelerator for Astron. The design goals were to provide electron beam pulses of 1000 amperes lasting 0.3 μs at an energy of 4 MeV. A burst of 200 pulses was to be injected into the Astron tank at a 500 kHz rate to establish quickly a stable "E" layer. Following the creation of an "E" layer the pulse rate would drop to 2500 pps which should be sufficient to compensate for the loss rate of electrons from the "E" layer. Of prime importance in this design was a vacuum tube switch capable of handling the current needed to drive the transformer cores in the accelerator as well as the 1000 ampere beam. According to the specifications, an experimental tube under development by one tube manufacturer should serve the purpose. This tube was also very attractively priced, costing $6,000; most other tubes which could have been used cost $30,000. (auth)

26641 (UCID-15638) SIMPLE ENERGY RECOVERY SYSTEM USING AN ENERGY-SPREAD BEAM PASSED THROUGH A TRANSVERSE ELECTRIC FIELD. Hamilton, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Apr 1970. 10p. Dep. NTIS $4.00.

A transverse electric field is proposed as an alternative system for electrostatically recovering the energy of an energy-spread beam. In this system, the beam is energy analyzed before the particles are decelerated for energy recovery. The advantage of this system is the ease of analysis and predicting its performance in respect to particle trajectories. The energy resolution can be improved by taking advantage of the focusing properties of the transverse electric field. This system is subject to the same aberrations as the other proposed systems, i.e., the effects of beam dispersion in space and direction, beam space charge, and target geometry. As an example, aberrations in energy analysis and consequent losses are computed for a system, with no attempt made as yet to optimize its parameters. The overall efficiency of this example is 70% to 80%. With improvements and optimization, a transverse electric field system may be expected to recover beam energy with 90% efficiency. (auth)

26642 (UCRL-51593) COMPUTER SIMULATION OF THE PERIODIC ELECTROSTATIC FOCUSING CONVERTER. Barr, W. L.; Howard, B. C.; Moir, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jun 1974. Contract W-7405-eng-48. 19p. Dep. NTIS $4.00.

A computer study was made of the various physical processes that take place in the periodic electrostatic focusing, direct energy converter. Computer simulation techniques are described and the results are presented. The effect that space charge, secondary electrons, beam size, charge exchange, and ionization have on conversion efficiency is examined. The results are applied to the design of a reactor. Finally, future plans for studies of direct converters are discussed. (auth)

26643 (UCRL-74486) SOME GENERAL DESIGN CONSIDERATIONS REGARDING LASER-FUSION CTR POWER PLANTS. Freeman, B.; Wood, L.; Nuckolls, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1971. 9p. (CONF-711160-1). Dep. NTIS $4.00.

From American Physical Society meeting; Madison, Wisconsin, USA (15 Nov 1971).

Very rapid recent progress in the development of high-energy pulsed laser systems and the present advanced state of thermonuclear explosive technology raise the possibility that a laser-initiated thermonuclear microexplosion approach to the CTR problem may be the first successful one. Some of the basic constraints imposed on reactor design and operation by the laser energy input requirements and thermonuclear microexplosion environment are discussed, and engineering problems and tentative solutions elucidated. The possibility of moderately efficient direct conversion of microexplosion energy to electrical form is described. Economics of laser-fusion power plants are very briefly treated. (auth)

26644 (UCRL-75087) SUPER-HIGH DENSITY APPROACH TO LASER-FUSION CTR. Wood, L.; Nuckolls, J.; Thiessen, A.; Zimmerman, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1972. 32p. (CONF-720558-4). Dep. NTIS $4.75.

From 7th international conference on quantum electronics; Montreal, Canada (8 May 1972).

The CTR aspects of laser-initiated burn of thermonuclear fuel precompressed to super high densities are discussed, including laser performance requirements and trade-offs, and scaling relations. Breakeven energy levels, applicable laser technology and power plant considerations are treated. (auth)

26645 AXIAL DECELERATION AND FOCUSING OF AN UNNEUTRALIZED ELECTRON LAYER BY HELICAL RESISTORS. Lauer, E.J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 17: No. 4, 828-834 (Apr 1974).

An analysis is made of the interaction between an unneutralized, relativistic, cylindrical electron layer and resistive conductors that have a coaxial, helical geometry. It is assumed that the current per unit length varies slowly in the axial direction. There is an average axial decelerative force on the layer and, if the pitch angle of the helix is greater than a critical value, the axial force is inward (focusing) on electrons at both ends of the layer. (auth)

26646 POWERFUL CAPACITOR BANKS HAVING AN ENERGY CAPACITY OF 1.35 AND 2.7 MJ. Pavlovskii, A. I.; Smirnov, E. N.; Latysh, V. Ya.; Suvorov, V. N.; Cherkasov, A. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 134-138(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 122-126(1974).

Powerful MKB-1 and MKB-2 capacitor banks having an energy capacity of 1.35 and 2.7 MJ are described, which are designed for experiments in the field of physics of fast processes. The bank is made up of IM 30/3 capacitors with a working voltage of 30 kV and an overall capacitance of 3 and 6 mF, respectively. The self-inductance of the impulsing circuit of the MKB-1 is 10 nH, which ensures a pulse current of up to 10 MA for operation into a low-inductance load. The current is commutated by controlled radial vacuum spark gaps, each of which has an inductance of 15 nH, a working voltage of 45 to 50 kV, and a current of up to 2 MA. A high-current switch is introduced into the MBK-1 and -2 circuits which allows operative switching of the bank to one of the lines that feeds energy to the experimental devices. The installations are constructed in the form of an identical parallel section with cable connection of the elements in the impulsing circuit. The sections are connected to the loads by disk current collectors. The MKB-2 installation is distinguished by a doubled number of sections. (auth)

26647 PLASMA AS AN ENERGY BEARER. Simonyi, K. (Muszaki Tudomanyok Osztalyanak, Budapest). Musz. Tud.; 48: No. 1-2, 119-138(1974). (In Hungarian).

The completely ionized deuterium–tritium mixture heated to several million degrees — still in the plasma state — is theoretically able to provide a controlled and continuous supply of useful energy by nuclear fusion. The difficulties to be overcome when practically realizing this theoretical possibility are discussed, and the results summarized. Several years of intensive research work and investments in billions of dollars are needed to experimentally prove the possibility of controlled energy generation by fusion, not to speak of the economical questions. After this, a further decennium will be needed to decide the question of economical feasibility. All these efforts are justified by the following advantages: unlimited resources of raw material and operation without combustion products and radioactive waste. Therefore, success would liberate humanity from its energy problems as well as from important problems of environment pollution. (auth)

26648 DIRECT OSCILLOSCOPIC ANALYSIS OF WAVE PROCESSES IN A MAGNETIZED PLASMA. Kopiczynski, T.; Zakrazewski, Z.; Stirand, O. (Polska Akademia Nauk, Gdansk). J. Phys., D (London); 7: No. 10, 1402-1405(1 Jul 1974).

The paper deals with an experimental analysis of oscillations existing in a magnetized laboratory plasma. A simple arrangement allows the direct photographing of a diagram from a CRO screen which shows the main features of wave processes in the whole range of the applied magnetic field. Examples of results obtained in the magnetized positive column of glow discharges in neon and helium are presented. (auth)

26649 DYNAMICS OF INTENSE RELATIVISTIC ELECTRON BEAMS IN TOROIDAL FIELDS. Benford, J.; Guillory, J.; Stallings, C. (Physics International Company, San Leandro, California 94577). J. Appl. Phys. 45: No. 4, 1657-1666 (Apr 1974).

Intense relativistic electron beams were propagated around a 180° toroidal sector to study beam dynamics in toroidal fields. The major beam drift under conditions for neutralization of self–fields was along $-R\times B$ and scaled as $\gamma Z/B_t$, where Z is the propagated distance, B_t the toroidal field, and γ the relativistic factor. This is indicative of curvature and ∇B drifts. Use of conducting walls caused an additional $F\times B$ drift around the chamber due to image current forces. Analysis of the distortion of a propagating rectangular beam shows that beam electrons follow field lines. Preliminary experiments on counterstreaming beams show inefficient reflection of beams from opposing diodes. Application of these results to beam injection and confinement in toroidal magnetic fields is discussed. (auth)

Wave Phenomena

Refer also to abstracts 26537, 26557, 26614, 26615, and 27814.

26650 (JINR-P9-7992) INTERACTION OF PLANE LANGMUIR SOLITONS. Abdulloev, Kh. O.; Bogolyubskii, I. L.; Makhan'kov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 21p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The dynamics of the Langmuir soliton interaction was studied. With the help of numerical simulation and on the basis of the semi-quantitative analytical estimates there was found the region of parameters at which the fusion of two solitons takes place. The interaction of solitons from a plane model with the periodical boundary condition was considered. The limits of application of such a problem are considered. (auth)

26651 (UCID-15546) LOW-FREQUENCY ELECTRON OSCILLATIONS IN BOUNDED PLASMAS. Baldwin, D. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Dec 1969. Contract W-7405-eng-48. 36p. Dep. NTIS $5.00.

The effects of finite plasma length, finite electron temperature, and the existence of low density external plasma upon low-frequency electron oscillations in a strongly magnetized plasma are considered. The purpose is to consider damping mechanisms available to these modes in mirror machines when they may be unstable due to coupling to ions with a loss-cone distribution. It is found in zero-temperature that the rate of decay of the mode due to leakage from the high- to low-density regions is little altered by changing a discontinuous density transition to a narrow but distributed one. Finite but small electron temperatures introduce traditional Landau damping and an altered version of electron-wave interaction which occurs in the presence of the static potentials of the density transition region. Finally, when the temperature is high enough that the electrons spend a small part of a period in the transition region, but low enough that the Debye length is small compared to the thickness of this region, we find that a wave is almost perfectly reflected by the transition region, resulting in only weak damping of the electron oscillations. (auth)

26652 FLUID THEORY OF REFLECTED PARTICLES IN ION–ACOUSTIC SHOCKS. Manheimer, W.M.; Haber, I. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Fluids 17: No. 4, 706-715 (Apr 1974).

The time–independent equation of motion for a one–dimensional ion fluid of velocity v and temperature T in an electric field E is $dv/dx = (eE/Mv)/(1 - 3T/Mv^2)$. This equation has a singularity at $Mv^2 = 3T$. This singularity is of crucial importance in any shock whose downstream state satisfies $3T > Mv^2$. Assuming a square (waterbag) ion distribution function, one shows that the singularity occurs where the first ion is reflected. By adding the presence of a second (reflected) fluid, it is possible to join these two fluids to form a single fluid beyond the singularity. Using this technique the structure of ion acoustic shocks containing reflected particles is found, and it is shown that the solutions are identical to direct solutions of the Vlasov equation. The advantage of the fluid formulation is that one can investigate the effect of anomalous friction and energy exchange between incident and reflected beams. (auth)

26653 NONLINEAR STOCHASTIC THEORY FOR A PLASMA DRIVEN BY STRONG HIGH–FREQUENCY ELECTRIC FIELDS. di Bona, G.; Masselot, C. (Comissariat à l'Energie Atomique, Centre d'Etudes de Limeil, 94190–Villeneuve–Saint–Georges, France). Phys. Fluids 17: No. 4, 739-745 (Apr 1974).

The interaction of an electron–ion plasma with a strong high–frequency electromagnetic field is studied by means of the Stratonovitch stochastic method. The hierarchy of equations obtained is broken by means of an expansion in power of a small dimensionless parameter. The solution of this set of equations leads to the computation of density fluctuations spectral densities, dynamical friction, and diffusion terms of the evolution equation for the one–particle distribution function. (auth)

26654 ABSORPTION OF LASER RADIATION IN A H–He PLASMA. I. THEORETICAL CALCULATION OF THE ABSORPTION COEFFICIENT. Stallcop, J.R. (Ames Research Center, National Aeronautics and Space Administration, Moffett Field, California 94035). Phys. Fluids 17: No. 4, 751-758 (Apr 1974).

The theory for calculating the absorption of laser radiation by hydrogen is outlined for the temperatures and pressures of common laboratory plasmas. Nonhydrogenic corrections for determining the absorption by helium are also included. The coefficients for the absorption of He–Ne laser radiation at the wavelengths of 0.633, 1.15, and 3.39 μm in a H plasma is presented for temperatures in the range 10 000–40 000°K and electron number densities in the range 10^{15}–10^{18} cm^{-3}. The total absorption of a H–He plasma calculated from this theory is compared with the measured absorption. The theoretical composition of the H–He absorption is analyzed with respect to the significant absorption processes, inverse bremsstrahlung, photoionization, resonance excitation, and photodetachment. (auth)

26655 ABSORPTION OF LASER RADIATION IN A H–He PLASMA. II. EXPERIMENTAL MEASUREMENT OF THE

ABSORPTION COEFFICIENT. Billman, K.W.; Rowley, P.D.; Stallcop, J.R.; Presley, L. (Ames Research Center, National Aeronautics and Space Administration, Moffett Field, California 94035). Phys. Fluids 17: No. 4, 759-764 (Apr 1974).

The absorption coefficients of 0.633−, 1.15−, and 3.39−μm laser radiation for a homogeneous H−He plasma have been measured in the temperature range of 12.2 to 21.7($\times 10^3$ °K) and in the electron number density range 0.45 to 6.5($\times 10^{17}$ cm^{-3}). Good agreement is found between the experimentally determined total absorption for each of the wavelengths and that calculated from theory. Furthermore, because the 3.39−μm absorption is dominated by inverse bremsstrahlung while the 0.633−μm absorption is dominated by photoionization and resonance absorption, the experiment indicates a correct assessment by the theory of these individual absorption mechanisms. (auth)

26656 THEORY AND SIMULATION OF COLLISIONAL DAMPING OF LONGITUDINAL WAVES IN A TWO−DIMENSIONAL PLASMA. Klein, H.H.; Krall, N.A. (University of Maryland, College Park, Maryland 20742); Orens, J.H. Phys. Fluids 17: No. 4, 735-738 (Apr 1974).

The collisional damping of plasma oscillations is studied by numerical simulation techniques. The results agree with the theoretical calculation of collisional damping in a two−dimensional plasma, resolving discrepancies which had previously existed between analytic and simulation approaches to this problem. (auth)

26657 NEW ELECTRON−WAVE AMPLITUDE OSCILLATION DUE TO AN INITIAL SPATIAL DISTURBANCE. Sugihara, R.; Kamimura, T. (Institute of Plasma Physics, Nagoya University, Nagoya, Japan). Phys. Fluids 17: No. 4, 786-790 (Apr 1974).

When an initial disturbance in a plasma is so strong that $f_0(\lambda)$ [$f_0(v)$: unperturbed distribution, λ: phase velocity] and $\hat{g}(\lambda)\cos kx$ [$\hat{g}(v)\cos kx$: disturbance] are of the same order, the spatial inhomegeneity represented by the latter causes a new type of amplitude oscillation while the usual amplitude oscillation predicted by O'Neil is not sensitive whether $\hat{g}(\lambda) = 0$ or not. This is due to the fact that the initial spatial disturbance survives around λ unsubjected to phase mixing for some time and causes a finite shift of the real part of the frequency which modifies the pattern of the trapping region. The most remarkable feature of this oscillation is that the amplitude almost always remains larger than the initial one. The maximum amplitude of the electric field E is $E_0[1+O(\hat{g}^2(\lambda)/k^4E_0^2)]$, where $\hat{g}(\lambda)$, k, and the initial field E_0 are normalized with (n_0/v_{th}), the Debye shielding constant and the square root of the kinetic energy $(4\pi n_0 T_e)^{1/2}$, respectively. (auth)

26658 SELF−MODULATION AND SELF−FOCUSING OF ELECTROMAGNETIC WAVES IN PLASMAS. Max, C.E.; Arons, J. (University of California, Berkeley, California 94720); Langdon, A.B. Phys. Rev. Lett. 33: No. 4, 209-212 (22 July 1974).

The nonlinear frequency shift of a strong electromagnetic wave in a plasma, due to weak relativistic effects and the $\vec{v}\times\vec{B}$ force, can cause modulation and self−focusing instabilities. These processes are explored, and their relation to self−focusing driven by the ponderomotive force is described. (auth)

26659 OBSERVATION OF THE COUPLED MODE OF A COLLISIONAL DRIFT WAVE AND AN ALFVÉN WAVE. Nishida, Y. (Department of Electrical Engineering, Utsunomiya University, Utsunomiya, Japan); Ishii, K. Phys. Rev. Lett. 33: No. 6, 352-355 (5 Aug 1974).

We observe a low−frequency instability with $\omega \ll \omega_{ci}$ in a steady high−density plasma ($n_0 \simeq 10^{13-14}$ cm^{-3}). This instability has components of magnetic field fluctuations as well as density fluctuations. By introducing the dispersion relation, the instability is interpreted as the coupled mode of the collisional drift wave and the Alfén wave. (auth)

26660 DELAYED EMISSION OF CYCLOTRON HARMONICS TRIGGERED BY A HIGH−POWER MICROWAVE PULSE. Ohyabu, N.; Sasaki, S.; Kawashima, N. (Institute of Space and Aeronautical Science, University of Tokyo, Komaba, Meguro−ku, Tokyo, Japan). Phys. Rev. Lett. 33: No. 6, 344-346 (5 Aug 1974).

We study the interaction of high−power microwaves with a magnetized plasma. Delayed emissions at cyclotron harmonics are observed after the termination of the pumping wave when the frequency of the pumping is equal to one of the harmonics of the cyclotron frequency and is near the plasma frequency. (auth)

26661 ELECTROMAGNETIC RADIATION FROM ELECTRON−BEAM EXCITATION OF SURFACE WAVES IN A BOUNDED, MAGNETIZED PLASMA. Aronov, B.I.; Bogdankevich, L.S.; Rukhadze, A.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.−Tech. Phys. 18: No. 12, 1569-1571 (June 1974).

The results of an earlier work are generalized to the case of a magnetized plasma. It is found that surface waves can be excited by an electron beam in a plasma cylinder with a free surface only in a relatively weak magnetic field (electron gyrofrequency much smaller than the electron plasma frequency, $^{1)}\omega_{L_2} > \Omega_e$).If the beam is magnetized, i.e., if $\Omega_e > \omega_{L_2}(n_1/n_2\gamma)^{1/3}$, only a single (l=0) surface mode is excited in a tenuous plasma, in which $r^2{}_0\omega^2_{L_2} < 2u^2\gamma^2$. In a dense plasma, many modes are excited simultaneously. The radiation flux (the Poynting vector) is calculated in the single−mode case and the efficiency of the system as a radiator is estimated. (auth)

26662 RESONANCE RADIATION OF A PLASMA MOVING IN A NARROW−SLIT PERIODIC WAVEGUIDE. Gestrina, G.N.; Gestrin, G.N.; Shestopalov, V.P. (Institute of Radiophysics and Electronics, Academy of Sciences of the Ukrainian SSR). Sov. Phys.−Tech. Phys. 18: No. 12, 1572-1577 (June 1974).

An analysis is made of the characteristics of the diffraction radiation resulting from the excitation, by a modulated electron beam, of a narrow−slit periodic waveguide filled with a "magnetized" plasma with a moving electron component. Resonant conditions for the corresponding closed system are treated. The specific energy flux carried by the propagating wave is derived. The range of applicability of the theory is discussed. (auth)

26663 EXCITATION OF ALFVÉN BY FAST IONS IN A FINITE−β PLASMA. Kaladze, T.D.; Lominadze, D.G.; Stepanov, K.N. (Institute of Applied Mathematics, Tbilisi State University). Sov. Phys.−Tech. Phys. 18: No. 12, 1583-1584 (June 1974).

In a plasma whose pressure is higher than or on the order of the magnetic pressure MHD Alfvén waves can be excited by a small group of fast ions (charged products of fusion reactions). There is a critical density of fast ions above which an instability arises. This critical density is governed by the Cerenkov absorption of Alfvén waves by plamsa ions. (auth)

26664 THEORY OF IONIZATION WAVES. Alanakyan, Y.R. (All−Union Scientific−Research Institute of Physicotechnical and Radiotechnical Measurements). High Temp. 11: No. 6, 1029-1032 (July 1974).

A dispersion relation is derived for an ionization wave under conditions when the plasma can be characterized by a characteristic frequency of ionization−diffusion oscillations. It is shown that the presence of negative ions can lead to growth of an ionization wave. (auth)

26665 USE OF SMALL−AMPLITUDE SHOCK WAVES TO PROBE AN AFTERGLOW PLASMA. Kabanov, G.L. Sov. Phys.−Tech. Phys. 18: No. 11, 1486-1487 (May 1974).

The compression of an afterglow helium plasma by weak shock waves is investigated experimentally. It is shown that the ratio of the integrated intensity of the afterglow before and after compression by a shock wave of fixed amplitude remains constant during the later stages of the decay (2.3 msec ⩽ t ⩽ 12 sec); this ratio can be used as a criterion that characterizes the constancy of the general decay mechanism. (auth)

26666 NONLINEAR INTERACTION OF A LOW−DENSITY ELECTRON BEAM WITH MONOCHROMATIC OSCILLATIONS OF A SPATIALLY BOUNDED PLASMA. Chogovadze, M.E. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.−Tech. Phys. 18: No. 11, 1446-1449 (May 1974).

A study is made of the excitation, by a low−density electron beam, of a nonlinear volume wave in a plasma that completely fills a waveguide and a surface wave in a plasma cylinder with a free surface. The cases of a magnetized beam and an unmagnetized plasma, i.e., $(n_1/n_0)^{1/3}\gamma\omega_{LO} \ll \Omega \ll \omega_{LO}$, are considered. The minimum amplitude of the field potential above which the wave can be stationary is determined as a function of the beam parameters as well as the relative energy density of the electrostatic field in a spatially bounded plasma. (auth)

26667 COLLISIONLESS SHOCK WAVES. Sanderson, J. J. (Saint Andrews Univ., Scotland). pp 53-73 of Summer School on Plasma Physics and Solar Radioastronomy. Vol. 1. Mangeney, A. (ed.). Meudon, France; Observatoire de Paris-Meudon (1973).

From proceedings of the summer school on plasma physics and solar radioastronomy; Ile de Re, France (4 Sep 1972).

Definition of collisional shocks and shocks in collisionless plasmas are given. Shock formation, jump conditions, structure energy and entropy are analyzed in both cases. Mathematical models of laminar shocks (perpendicular or oblique) and turbulent shocks are presented. (FR)

26668 SHORT PHENOMENOLOGICAL SURVEY OF NON-LINEAR EFFECTS IN PLASMA PHYSICS. Pellat, R. (Ecole Polytechnique, Paris). pp 74-88 of Summer School on Plasma Physics and Solar Radioastronomy. Vol. 1. Mangeney, A. (ed.). Meudon, France; Observatoire de Paris-Meudon (1973).

From proceedings of the summer school on plasma physics and solar radioastronomy; Ile de Re, France (4 Sep 1972).

Wave–particle and wave–wave interaction in a collisionless plasma in the absence of a magnetic field were studied. Small amplitude waves can undergo resonant reactions with particles (the Landau effect). For waves of large amplitude two cases are distinguished, i.e., a narrow wave packet or a wide spectrum. The interaction of two waves of the same wave packet leads either to the nonlinear Landau damping or to mode–mode coupling. Both phenomena are analyzed. Nonlinear plasma theory and observation of type III solar radio bursts are compared. (FR)

26669 EXCITATION OF ALFVÉN WAVES IN DECAY INSTABILITIES. Elfimov, A.G.; Nekrasov, F.M. Sov. Phys.–Tech. Phys. 19: No. 1, 9-11 (July 1974).

The evolution of the wave numbers is studied for Alfvén waves transverse to a constant magnetic field. These waves are excited by the decay instability of a standing magnetoacoustic wave. It is shown that finite conductivity stabilizes the spectrum. The time required to establish a stationary spectrum is determined and the profile of the spectrum is found. Criteria are obtained for the stability of the Alfvén wave as a function of the plasma parameters and the amplitude of the pump wave. It is shown that there is no transfer of energy through the spectrum for a traveling pump wave. (auth)

26670 NONLINEAR PLASMA WAVES AND ION–ACOUSTIC WAVES IN AN ISOTROPIC PLASMA. Livadonov, V.S.; Fainshtein, S.M. (Zhdanov Gor'kii Polytechnic Institute). Sov. Phys.–Tech. Phys. 19: No. 1, 28-30 (July 1974).

Nonlinear longitudinal (plasma and ion–acoustic) waves in an isotropic plasma are investigated. An asymptotic method is used to derive truncated equations for the wave amplitude and phase. Particular solutions allowing for attenuation due to collisions and scattering by random inhomogeneities are analyzed; the nature of the stationary envelopes is clarified. Estimates are given for a plasma in a semiconductor like InSb. The hydrodynamic approximation is used. (auth)

26671 CONVERSION OF AN ELECTROMAGNETIC WAVE INTO AN ION–ACOUSTIC WAVE IN AN INHOMOGENEOUS PLASMA. Kondratenko, A.N.; Kuklin, V.M. (A. M. Gor'kii Khar'kov State University). Sov. Phys.–Tech. Phys. 19: No. 1, 25-27 (July 1974).

An electromagnetic wave incident on an inhomogeneous, highly nonisothermal plasma is analyzed. The electric vector of the wave lies in the plane of incidence. The plasma density variation is linear. If the inhomogeneity is pronounced, so that the limiting ion plasma frequency found from the condition $\Omega_i(a) = \omega$ is in the skin layer, an ion–acoustic wave can be excited in the plasma. An equation is derived for the field of the ion–acoustic wave and solved in the asymptotic regions. The ion–acoustic wave is excited near the point $\Omega_i(a) = \omega$, where its amplitude becomes very large; it propagates into the plasma with an amplitude which decays like $\omega \ll \Omega_i(x)$ in inverse proportion to the density. If the skin depth for the electromagnetic wave satisfies $\delta \ll a$, the amplitude of the ion–acoustic wave is exponentially small. (auth)

26672 SECOND–HARMONIC GENERATION AND EMISSION IN WAVE CONVERSION AT A PLASMA BOUNDARY. Kondratenko, A.N.; Shaptala, V.G.; Kuklin, V.M. (A. M. Gor'kii Khar'kov State University). Sov. Phys.–Tech. Phys. 19: No. 1, 22-24 (July 1974).

The amplitude of the second harmonic emitted from a plasma layer is found for the case in which an electromagnetic wave incident from vacuum excites a longitudinal wave in the plasma. The intensity of the second harmonic at twice the plasma frequency is found as a function of the plasma width, the intensity of the (constant) magnetic field, and the angle of incidence of the wave at the fundamental frequency. (auth)

26673 EMISSION OF WAVES FROM A PLASMA LAYER. Davydova, T.A.; Zhmudskii, A.A. (T. G. Shevchenko Kiev State University). Sov. Phys.–Tech. Phys. 19: No. 1, 12-15 (July 1974).

Frequency spectra are given for waves emitted from a plane plasma layer at a finite temperature in the absence of an external magnetic field. As a result of the energy loss by radiation the frequencies are complex and this means that the waves are damped in the layer. This damping must be taken into account together with the other loss mechanisms in any study of the propagation and interaction of waves in bounded plasma systems. (auth)

26674 REFLECTING PROPERTIES OF AN INHOMOGENEOUS ANISOTROPIC PLASMA LAYER. Zhivulin, V.A.; Makarov, G.I. (A. A. Zhdanov Leningrad State University). Sov. Phys.–Tech. Phys. 19: No. 1, 123-123 (July 1974).

The transmission of a TM electromagnetic wave through an inhomogeneous layer of a cold plasma with electron polarization in a constant homogeneous magnetic field is analyzed. The layer is unbounded and homogeneous along the y and z axes but has a finite thickness $2x_0$ and is inhomogeneous along the x axis. The electric vector of the incident wave lies in the xz plane. The diagonal component of the relative dielectric permittivity tensor $\epsilon_{xx}(x)$ for the plasma has (in the absence of losses) an n–th order zero (n=2,4,6...) at the point x=0. If there are no losses and the constant magnetic field is directed along the y axis, the TM wave is completely shielded by the layer. The shielding effect is not observed for other directions of the magnetic field. (auth)

26675 IONIZATION OSCILLATIONS IN A PLASMA IN THE PRESENCE OF IONIZING RADIATION. Vainer, B.V. (Rostov–on–Don State University). Sov. Phys.–Tech. Phys. 19: No. 1, 119-120 (July 1974).

It is shown that the presence of ionizing radiation in a plasma can cause an instability. Expressions are obtained for the frequency and growth rate of the ionization oscillations. (auth)

26676 LONGITUDINAL OSCILLATIONS IN AN ULTRARELATIVISTIC ELECTRON PLASMA. Dzhavakhishvili, D.I. (Tbilisi State University). Sov. Phys.–Tech. Phys. 19: No. 1, 115-115 (July 1974).

An investigation is made of longitudinal oscillations excited by a low–density beam of cold electrons in an ultrarelativistic electron plasma with thermal velocities of the order of the velocity of light. The growth rate is found and compared with the case of a nonrelativistic electron plasma. (auth)

26677 TEST WAVE COEXISTING WITH A LARGE AMPLITUDE ELECTRON PLASMA WAVE. DeNeef, P. (Physics Department, University of California at San Diego, La Jolla, California 92037). Phys. Fluids 17: No. 5, 981-986 (May 1974).

When a small test wave is launched near the frequency of a large amplitude electron plasma wave, the behavior of the test wave is determined by the nonlinear dynamics of the electrons that are trapped by the large amplitude wave. Consequently, the amplitude of the test wave oscillates coherently with the trapping oscillations in the amplitude of the main wave. The behavior of a small, launched, test wave at frequency ω is observed as a function of its frequency separation from a large amplitude electron plasma wave at frequency ω_0. The initial damping and subsequent amplitude oscillations of the test wave are compared with a calculation in which the test wave is treated as a slow modulation of the amplitude and phase of the main wave. Test wave experiments agree with the calculation when $\omega_0 - 4\pi/T < \omega < \omega_0 + \pi/T$, where T is the transit time of the main wave through the experiment. When the spontaneously unstable frequency of the lower sideband is within this range, the slow amplitude oscillations of the sideband agree with the calculation. When the frequency of the test wave is sufficiently far below $\omega_0 - 4\pi/T$, the test wave damps according to linear theory. The phase velocity at which the test wave behaves essentially linearly determines the velocity of the fastest electrons that interact strongly with the wave. (auth)

26678 TURBULENT DISPERSION OF ION CYCLOTRON WAVES: THEORY AND EXPERIMENT. Benford, G.; Rynn, N.; Thomson, J.J.; Williamson, W.S. (Physics Department, University of California at Irvine, Irvine, California 92664). Phys. Fluids 17: No. 5, 1001-1007 (May 1974).

Particles in or near resonance with a plasma wave undergo perturbations of their equilibrium orbits due to stochastic fields. This contributes added diffusion damping to any wave in the plasma. In a steady–state experiment this mechanism can cause the saturation of a wave. A theory of the current–driven ion cyclotron instability modified by turbulent damping based on addition of a damping term to the linear dispersion relation is presented. The turbulent damping is interpreted as an upper bound on the linewidth of the wave. As current varies, the frequency and linewidth of the mode alter. Once the frequency of the ion cyclotron wave is lowered to nearly the ion cyclotron frequency, mode coupling to an ion–acoustic wave seems to occur, damping the oscillations. Until this point, detailed predictions of theory agree well with experiment. (auth)

26679 WHISTLER DECAY INSTABILITY IN THREE DIMENSIONS. Wright, T.P. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Fluids 17: No. 5, 1026-1031 (May 1974).

A generalized treatment of the three–wave decay of oblique whistler/electron cyclotron waves into other whistler/electron cyclotron waves is presented which clarifies the three–dimensional aspects of the process. The generalized expression for the growth rate is given and several special cases are considered, establishing the existence of a strong instability. It is shown that there is no instability when the three wavenumber axes are coplanar with the background magnetic field in the plane except for the special case when one of the waves propagates along the background magnetic field. (auth)

26680 STIMULATED CYCLOTRON RESONANCE SCATTERING AND PRODUCTION OF POWERFUL SUBMILLIMETER RADIATION. Sprangle, P.; Granatstein, V.L. (Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 25: No. 7, 377-379 (1 Oct 1974).

Interaction of a high-frequency electromagnetic pump wave with a magnetized plasma is analyzed. Enhanced growth rates for parametric instability are found near cyclotron resonance. The result implies that tunable high-power submillimeter sources could be developed using intense relativistic electron beams. (auth)

26681 NONLINEAR SCATTERING FROM A WARM PLASMA COLUMN. Larsen, J. (Institute for Plasma Research, Stanford University, Stanford, California 94305). J. Appl. Phys. 45: No. 9, 3817-3824 (Sept 1974).

When a plane electromagnetic wave impinges normally on a plasma column, with its magnetic field vector parallel to the axis of the column, a series of (Tonks-Dattner) resonances are excited which have been described previously in the linear regime, by a warm plasma analysis using a scalar electron pressure and an inhomogeneous radial electron density profile. In this paper, the theory is extended to the weakly nonlinear regime, assuming a parabolic electron density profile. The nonlinear scattered power is obtained. The excitation of dipole resonances at two different frequencies produces a predominantly quadrupolar radiation pattern with minima in the direction of the incident wave vectors and approximately at right angles to it. In general, there is no nonlinear power radiated in the forward and backward directions. Numerical results for the nonlinear scattering coefficients are obtained in the special case of second-harmonic generation at dipole resonance. (auth)

26682 PLASMA-WAVE PRODUCTION BY TWO LASER BEAMS IN AN INHOMOGENEOUS PLASMA. Beaudry, G. (Institut de recherche de l'Hydro-Québec, Direction Sciences de base, Varennes, Québec, JOL 2PO, Canada). J. Appl. Phys. 45: No. 9, 3836-3839 (Sept 1974).

The problem of plasma-wave production by two beating laser beams is examined in the case of a linear density profile plasma. We assume that convection of the plasma wave dominates over dissipation. We show that the energy transferred to the plasma wave strongly depends on initial laser-beam intensities and on the density gradient scale length. For initial conditions leading to Raman backscattering we obtain an expression for the spatial growth of the reflected beam. (auth)

26683 PEAK EMISSION FROM SECOND HARMONIC GENERATION AT THE UPPER HYBRID LAYER. Cotsaftis, M. (Département de Physique du Plasma et de la Fusion Contrôlée, Centre d'Etudes Nucléaires, Association Euratom-CEA sur la Fusion, 92260 Fontenay-aux-Roses, France). Phys. Fluids 17: No. 3, 640-643 (Mar 1974).

Using a parabolic approximation for the propagation index of the electric field around the existing minimum of the upper hybrid curve, a closed and finite expression for the value of the peak energy radiated to infinity from the second harmonic generation in the hybrid layer is given and compared with the ST tokamak experiment. This calculation shows reasonable agreement with the observed value, indicating that in this case the peak is probably due to the second harmonic generation. (auth)

26684 NEW ION ACOUSTIC INSTABILITY. Leprince, P. (Laboratoire de Physique des Plasmas, Université de Paris-Sud, Centre d'Orsay, 91405 Orsay, France); Peyraud, J. Phys. Fluids 17: No. 3, 604-608 (Mar 1974).

In the presence of a quasiresonant high frequency field, a new type of ion acoustic instability is described. In using the macroscopic equations, it is possible to show that an ion acoustic wave can be unstable when the high frequency is close to the resonance frequency. The experiment is performed on an afterglow discharge; the secondary (or Dättner) resonance is excited and when the incident power increases, the reflected microwave is modulated by a low frequency corresponding to the frequency of the ion-acoustic oscillation. (auth)

26685 OBSERVATION OF THE ION WAVE TURBULENT SPECTRUM. Hara, T.; Honzawa, T.; Kawai, Y.; Watanabe, S.; Fujita, J. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Phys. Lett., A; 48: No. 3, 203-204(17 Jun 1974).

Turbulent spectrum of ion waves excited by an electron current is investigated experimentally, where electron drift velocity is measured directly by the rotatable Langmuir probe. (auth)

26686 DYNAMICS OF LANGMUIR TURBULENCE. Formation and Interaction of Solitons. Abdulloev, Kh. O.; Bogoljubskii, I. L.; Makhankov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett., A; 48: No. 3, 161-162(17 Jun 1974).

A computer study of the formation and interaction of Langmuir solitons allowing for the generation of ion-sound waves is presented. (auth)

26687 ATTENUATION OF NONLINEAR LANGMUIR WAVE IN THE INHOMOGENEOUS PLASMA. Karpman, V. I.; Istomin, Ja. N. (ISMIRAN, Academic City, Moscow Region, USSR). Phys. Lett., A; 48: No. 3, 197-198(17 Jun 1974).

Electrostatic wave evolution due to the wave-particle interaction in a weakly inhomogeneous plasma is investigated. It is shown that even a small gradient leads to the visible wave attenuation in the nonlinear stage, contrary to the homogeneous plasma. (auth)

26688 NONLINEAR CHARACTERISTICS OF LARGE AMPLITUDE BERNSTEIN WAVES. Matsumoto, H.; Miyatake, S.; Kanemasa, A. (Kyoto Univ. (Japan)). Phys. Lett., A; 48: No. 3, 195-196(17 Jun 1974).

Nonlinear characteristics of large amplitude Bernstein waves are examined. With increasing the wave amplitude, a stretch of the wave length is observed together with a temperature increase and an excitation of ion plasma waves indicating a nonlinear wave-particle or nonlinear wave-wave interaction. (auth)

26689 FORM AND ERGODIC BEHAVIOUR OF NONLINEAR WAVES IN A WARM TWO COMPONENT PLASMA. Infeld, E. (Institute of Nuclear Research, Warsaw (Poland)). Phys. Lett., A; 48: No. 3, 175-176(17 Jun 1974).

A class of nonlinear, small Mach number waves in a warm magnetized plasma is given. These waves are then investigated for ergodicity. These results that the wave is ergodic if a parameter, depending only on the Alfven-Mach number for the wave, is irrational. (auth)

26690 PHASE VELOCITY VARIATION OF ELECTROSTATIC WAVES. Nyack, C. A. (Physics Dept., Univ. of the West Indies, Barbados); Christiansen, P. J. (Sussex Univ., Brighton (UK)). Phys. Lett., A; 48: No. 3, 191-192(17 Jun 1974).

Phase velocity variation of the large amplitude electrostatic wave excited in a beam-plasma system and its dependence on wave amplitude is described. The results are in qualitative agreement with the single wave model. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 26641 and 26642.

26691 NONLINEAR ION–ACOUSTIC WAVES IN A THERMIONIC CONVERTER. II TRANSIENT REGIME. Zherebtsov, V.A.; Shut'ko, A.V. Sov. Phys.–Tech. Phys. 18: No. 12, 1590-1593 (June 1974).

The growth of nonlinear ion–acoustic waves in a plasma diode is analyzed in the two–fluid hydrodynamics approximation. The analysis is based on the Bogolyubov asymptotic method. The time evolution of the amplitude and phase of the wave is found. The effect of the waves on the current flowing through the device is studied; it is found that the wave in a thermionic converter can reduce the current significantly. (auth)

26692 NONLINEAR ION–ACOUSTIC WAVES IN THE THERMIONIC CONVERTER. I. STEADY STATE. Zherebtsov, V.A.; Shut'ko, A.V. Sov. Phys.–Tech. Phys. 18: No. 12, 1585-1589 (June 1974).

An analysis is made of nonlinear ion–acoustic waves excited as a result of an instability due to processes occurring near the electrodes in a plasma diode. The analysis is based on the equations of two–fluid hydrodynamics with Coulomb collisions. The critical value of the characteristic dimensionless parameter of the problem, i.e., that determining the diodes stability, is found. The intensity of the steady–state waves and the nonlinear correction to the frequency are calculated by an asymptotic method analogous to the Poincaré method for the case in which this dimensionless parameter is slightly above the critical value. These results may also be useful in interpreting experiments on waves in Q machines. (auth)

26693 SUPERSONIC MHD GENERATOR OF HIGH EFFICIENCY IN A NONEQUILIBRIUM PLASMA. Belykh, A.D.; Gurashvili, V.A.; Golubev, V.S. (I. V. Kurchatov Institute of Atomic Energy). High Temp. 11: No. 6, 1152-1153 (July 1974).

It is experimentally demonstrated that an MHD generator with nonequilibrium conductivity can be the principal cause of the removal of up to 30% of the enthalpy of the plasma stream.

26694 DESIGN OF A HEAT–RESISTANT WALL FOR AN MHD GENERATOR TUBE. Dubasov, A.M.; Krasulin, Y.L.; Panferov, V.M. (High–Temperatures Institute, Academy of Sciences of the USSR). High Temp. 11: No. 6, 1140-1145 (July 1974).

A nonlinear theory of strain in refractories is used as the basis of a method of calculating thermal stresses in ceramic plate with one–sided heating; the conditions are those of a refractory wall consisting of several plates that have to retain their strength under transient heat fluxes. Calculations on the BESM–4 computer are presented for a multilayer ceramic wall as applicable to the channel of an MHD generator. (auth)

26695 CHARACTERISTICS OF MAGNETOHYDRODYNAMIC (MHD) POWER STATIONS IN RELATION TO THE ELECTRICAL CONDUCTIVITY OF THE PLASMA BEHIND THE MHD GENERATOR. Popyrin, L.S.; Pshenichnov, N.N.; Rogachev, A.P.; Sokol'skii, A.G.; Shumyatskii, B.Y. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 11: No. 6, 1135-1139 (July 1974).

The effect of the finite electrical conductivity of the plasma on the characteristics of MHD steam–turbine power stations with or without thermochemical reprocessing of the original fuel (by the methods of mixed conversion and pyrolysis) is considered. (auth)

26696 INSTABILITY AND MOTION OF FREE–CONVECTION TYPE IN THE CATHODE LAYER OF AN MHD GENERATOR. Nedospasov, A.V.; Khait, V.D. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 11: No. 6, 1125-1128 (July 1974).

We consider the instability in a channel of an MHD generator in a plane cathode layer of an electrically conducting incompressible medium due to the temperature dependence of the electrical conductivity. (auth)

26697 THE END EFFECT IN AN MHD GENERATOR WITH METALLIC WALLS AT THE INLET SEPARATED BY INSULATING PARTS FROM THE SECTIONAL ELECTRODE ZONE. Vatazhin, A.B.; Nemkova, N.G. High Temp. 11: No. 6, 1117-1124 (July 1974).

The electric field is considered for an MHD channel that simulates the input, working, and output zones of an MHD generator, which is part of a high–power plant working with an open cycle. In the input part of the channel there is a solid metal nozzle, which is separated from the working zone of the MHD generator by nonconducting parts. The channel walls in the working zone are sectional electrodes. The magnetic field is uniform in the zone of the sectional electrodes and in the adjacent part where there are nonconducting gaps, while the leakage zone includes some part of the metallic walls at the inlet. The channel geometry and design of the magnetic system in the output zone are as at the inlet. (auth)

26698 THERMAL CYCLE AND EFFECTIVENESS OF A MANEUVERABLE POWER ASSEMBLY WITH AN MHD GENERATOR AND TURBOGENERATOR. Kirillin, V.A.; Sheindlin, A.E.; Shelkov, E.M.; Shishkov, E.V.; Pashkov, S.A.; Latyshev, V.M. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 11: No. 5, 966-969 (May 1974).

The scheme of an MHD generator with the possibility of heavy–rate operating conditions which can operate in a wide range of loads was developed. The dependence of efficiency in a wide range of loads 25 to 130% N_{nom} was calculated for the proposed power assembly. (auth)

26699 INVESTIGATION OF HEAT EXCHANGE IN AN MHD GENERATOR CHANNEL. Kirillov, V.V.; Semenov, V.D. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 11: No. 5, 970-977 (May 1974).

A theoretical treatment of heat transfer and frictional drag, applicable to the conditions in the channel of an open–cycle MHDG, is presented. A calculation is made of the drag resistance and heat transfer for the turbulent flow along a flat wall of partially dissociated natural gas combustion products. The calculation is conducted for $10^5 \leq Re_x \leq 10^7$, $0.133 \leq T_w/T_e \leq 1$, $T_e \approx 2400$ to 3000°K. The degree of dissociation of the combustion products is fairly high in the temperature range indicated; at $T_e \approx 3000$°K, the dissociation energy comprises 46% of the enthalpy of the gas. The effect of various factors on the heat exchange under given conditions is shown. The data obtained is compared with the results of calculations by other methods. The results of an experimental study of heat exchange in large open–cycle MHD installations are cited. A comparison of the theoretical data with the experimental results is given. (auth)

Facilities and Equipment

Refer also to abstracts 26603 and 28559.

26700 (AD-774792) NUMERICAL ANALYSIS OF A COAXIAL FLASHLAMP-PUMPED RHODAMINE 6G DYE LASER. Theissing, H. H.; Wright, R. H. Jr.; Ewanizky, T. F. (Army Electronics Command, Fort Monmouth, N. J. (USA)). Dec 1973. 44p. (ECOM-4178). NTIS $3.25.

The coefficients of the laser rate equations describing a pulsed, coaxial flashlamp-pumped organic dye laser, which are not directly accessible, are determined from experimental data, such as shape of the pump, shape of laser output pulse and energy output of laser at optimum coupling. Computer solutions of the laser rate equations using these coefficients agreed with the experimentally measured laser pulse shape. Also, with the numerical data obtained, an energy balance between spontaneous emission, lost stimulated emission, and useful stimulated emission (laser output) could be established. The effects of amplified spontaneous emission (superradiance) on efficiency and beam quality are discussed. (auth)

26701 (AD-774793) BEAM QUALITY OF PULSED ORGANIC DYE LASERS. Ewanizky, T. F. (Army Electronics Command, Fort Monmouth, N. J. (USA)). Oct 1973. 32p. (ECOM-4163). NTIS $3.25.

Various aspects of flashlamp-pumped organic dye laser efficiency and beam quality are investigated. A coaxial Marx-Bank driver circuit and flashlamp system are described. Shock wave induced optical distortion in the active solution was identified as a cause for premature laser termination. Beam quality experiments and theoretical analysis indicate that intrinsically strong amplified spontaneous emission effects are responsible for the relatively large beam divergence typically observed in pulsed dye lasers. Flux-injection techniques and mode-locking in dye lasers are discussed as possible remedial measures. (auth)

26702 (AD-774911) INDUCTIVE ENERGY STORAGE SWITCHING TECHNOLOGY FOR HIGH REPETITION RATE

LASERS. Final Report, 1 May 1972–30 April 1973. Alting-Mees, H. (Hughes Research Labs., Malibu, Calif. (USA)). Aug 1973. Contract N60921-72-C-0306. 98p. NTIS $4.00.

The basic objective of this program was to determine the feasibility of a particular Hughes switching concept in a high repetition rate laser power conditioning system using inductive energy storage (IES). A second objective was to compare a conventional capacitive system and an inductive system (using the Hughes switching concept) in order to determine which system is the most appropriate for projected applications. The Hughes liquid-metal cathode plasma valve (LMPV) played a major role in this investigation because it is, at present, the only device capable of carrying high average currents with attendant recovery rates comparable to vacuum devices. The program was divided into three tasks. These tasks were: (1) Using the LMPV, evaluate experimentally different interruption methods; (2) through a scaling study provide a preliminary design of an 8.5-kA average, 10-kA peak, 100-kV LMPV; and (3) perform a systems study. (GRA)

26703 (JUL-1056-PP) DEVELOPMENT OF TEA-CO_2-LASERS AND THEIR USE IN PLASMA PHYSICS. Rusbueldt, D. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Plasmaphysik). Mar 1974. 22p. (In German). (AED-CONF-73-092-012; CONF-730481-1). INIS.

From spring meeting of the Deutsche Physikalische Gesellschaft: pulse physics, plasma physics and gas discharges, quantum optics; Berlin, F. R. Germany (9 Apr 1973).

19 figs.; 20 refs. with abstract.

High power carbon dioxide lasers, known as "transversely excited atmospheric pressure" (TEA) lasers, are discussed. These lasers produced for the first time in the middle infrared range at 10.6 ω wave length power in the gigawatt range, and one expects to reach terawatt power with pulse energies of more than one kilojoule. A special advantage of all CO_2-lasers is their more than 10 percent efficiency. (RW)

26704 (LA-5689-MS) GEOTHERMAL WELL TECHNOLOGY AND POTENTIAL APPLICATIONS OF SUBTERRENE DEVICES: A STATUS REVIEW. Altseimer, J. H. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1974. Contract W-7405-eng-36. 34p. Dep. NTIS $4.00.

The past, present, and some future aspects of the geothermal energy (GTE) industry have been reviewed with special attention given to geothermal well-drilling problems. Geothermal wells can be produced with present equipment and methods, mostly derived from the oil and gas industry, but costs are relatively high. Short-term improvements are needed in drilling rigs and auxiliary surface equipment, drill bits, bit-bearing lubrication systems, tubular goods, high-temperature muds and cements, logging and downhole sampling equipment, directional control equipment applicable to geothermal conditions, and in the use of a data bank for GTE wells to help optimize drilling programs. Two types of wells are needed: (1) small-diameter wells for exploration, reinjection, and disposal purposes, and (2) larger-diameter wells for production. To develop and greatly expand the use of GTE in the future, new methods and equipment are needed to penetrate hard abrasive rocks and to provide hole stabilization and support at the very high temperatures and other extreme conditions which can be encountered in GTE wells. New Los Alamos Scientific Laboratory concepts for penetrating rocks by use of rock-melting processes (called Subterrene concepts) offer potential solutions to some difficult GTE well-production problems. (auth)

26705 GAMMA RAY IRRADIATION FACILITY AT BOSE INSTITUTE. Biswas, M.; Chatterjee, M. L.; Roy, S. C.; Ghose, A. M. (Bose Inst., Calcutta). Sci. Cult. (Calcutta); 40: No. 4, 163-165(Apr 1974).

An irradiation chamber is described which was developed at the Bose Institute, Calcutta. Irradiation under high dose rates is achieved by placing the sample close to the source and uniformity of radiation over the sample is ensured by rotating the sample about an axis tangential to the isodose surface through the sample position. (LCL)

26706 A NEUTRON COLLIMATOR FOR ANIMAL IRRADIATIONS. Goldberg, E.; Barschall, H.H.; Booth, R.; Griffith, R.V. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550); Phillips, T.L. Med. Phys. 1: No. 3, 152-154 (1 May 1974).

A collimator for exposures of portions of small animals to 15–MeV neutrons is described. The radiation field behind the collimator was mapped with various detectors that determined dose, neutron spectra, and fluxes. (auth)

26707 EFFECTS OF X-RAY TUBE CURRENT AND VOLTAGE ON EFFECTIVE FOCAL–SPOT SIZE. Chaney, E.L.; Hendee, W.R. (Department of Radiology, University of Colorado Medical Center, Denver, Colorado 80220). Med. Phys. 1: No. 3, 141-147 (1 May 1974).

In general, the dimensions of the effective focal spot of an x–ray tube vary with tube current and voltage. This dependence on tube operating conditions has been noted in the literature but has not been investigated in detail. Star phantom measurements of seven focal spots for four x–ray tubes operated at a variety of tube voltages and currents show that effective focal– spot size varies as $IV^{-3/2}$. This dependence may be suppressed for the focal–spot dimension perpendicular to the tube axis, however, because of auxiliary electrostatic focusing. Experimental data are presented with a theoretical explanation of the relationship between effective focal–spot size and tube operating conditions. (auth)

26708 LASER–INDUCED PLASMA PERTURBATION STUDIES OF ENERGY TRANSFER IN CO_2 GLOW–DISCHARGE LASERS. Gower, M.C.; Carswell, A.I. (Department of Physics and CRESS, York University, Toronto, Canada). J. Appl. Phys. 45: No. 9, 3922-3929 (Sept 1974).

V–V and V–T energy transfer mechanisms have been investigated in CO_2 glow discharges using a pulsed laser plasma perturbation method. The appropriate rate equations are presented, the solutions of which were found to adequately describe the observed induced spontaneous emission and discharge current changes. From the spontaneous emission studies, it is possible to observe directly intermolecular V–V pumping between $CO_2(\nu_3)$ and both CO and N_2, while the temporal variations in discharge current permitted measurements to be made of the V–T rates for the (10^00) and (00^01) levels. New data for the deactivation of the (10^00) level in the discharge is presented along with quenching rates of (01^10) by H_2O and CO. In addition, both radial and longitudinal acoustic waves were found to propagate in the discharge following amplification or absorption of the 10.6–μm laser pulse. (auth)

26709 HEAT TRANSFER IN ONCE-THROUGH STEAM GENERATORS. Campolunghi, F. (CNEN, Rome); Cumo, M.; Urbani, G.; Vaccaro, G. Termotecnica (Milan); 28: No. 7, 385-402(Jul 1974). (In Italian).

There is a lack of information on the thermohydraulic design of subcritical, once-through tubular elements of steam generators. Available experimental data generally refer to short (a few meters) test sections, often heated at high surface heat fluxes (hundreds of W/cm^2). Practical situations, instead, pertain to very longer geometries with lower surface heat fluxes. A typical case is that of sodium-heated steam generators in ljquid metal fast breeder reactors. Otherwise, a different heat flux distribution may induce a different burnout power, with a different boiling length and, therefore different specific powers and costs of the whole plant. The necessity for further experimental investigation, possibly in full scale, is discussed. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 26699, 26709, 26969, 27582, 28699, 28777, and 28800.

26710 (IAE-2278) SOLUTION OF THERMAL CONDUCTIVITY PROBLEM BY MONTE CARLO METHOD. Kuznetsov, V. F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 20p. (In Russian). INIS.

Primarily the work of foreign authors is reviewed on the applicability of statistical methods to the solution of thermal conductivity problems. A description is given for three schemes of effectuating a Monte Carlo method in the problem of random deviation: a fixed random deviation, a smoothed random deviation, and a modified Monte Carlo method not using random numbers or the EXODUS method (method of migration). Consideration is given to problems of introducing limits and limiting conditions while using a probability approach. Results are presented on temperature calculations in a two-dimensional plane by the EXODUS method. Conclusions are presented on the possibilities of success in using the Monte Carlo method and its modifications for solving thermal conductivity problems in multi-dimensional regions under the most varied boundary conditions. (tr-auth)

26711 (KFK-1958) HEAT TRANSFER TO LIQUID HELIUM IN VERTICAL COOLING CHANNELS WITH CONSTANT AND PULSED HEAT FLOW. Schmidt, C.; Turowski, P. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). May 1974. 24p. (In German). Dep. NTIS (US Sales Only) $4.25.

Data on heat transfer to liquid helium were measured in vertical cooling channels of 10 cm length with various cross sections and surfaces. The maximum heat flux for nucleate boiling is indepen-

dent of surface treatment. Surprisingly, large peaks in temperature rise were found before nucleate boiling sets in. Distinct hysteresis effects appeared in connection with rough surfaces. Studies of the temperature behavior involving the switching-on of a constant heating power and experiments with pulsed thermal loads showed that film boiling does not start until after some short delay. Therefore, larger maximum heating powers may be tolerated in pulsed operation. (auth)

26712 (MIT-DSR-73413-79) EFFECT OF SURFACE CONDITIONS ON BOILING CHARACTERISTICS. Lorenz, J. J.; Mikic, B. B.; Rohsenow, W. M. (Argonne National Lab., Ill. (USA); Massachusetts Inst. of Tech., Cambridge (USA)). 1974. 5p. (CONF-740925-1).

From 5th international heat transfer conference; Tokyo, Japan (3 Sep 1974).

A unified model relating surface variables to the nucleate pool boiling characteristics was developed. A simple vapor trapping mechanism was postulated and a geometrical model constructed for idealized conical cavities relating the effective radius for nucleation to cavity radius, cone angle and contact angle. This model for individual cavities was extended to the entire surface providing an expression for the cumulative site density in terms of geometrical parameters. A transient heat conduction model was experimentally verified for water and organics at atmospheric pressure and was incorporated into a unified expression showing explicitly the role of surface geometry and contact angle. (auth)

26713 TEMPERATURE FIELD IN A FLOW OF WATER IN A CIRCULAR PIPE WITH SURFACE BOILING. Alekseev, G.V.; Ibragimov, M.K.; Kulikov, B.I.; Sabelev, G.I.; Tarin, A.A. (Physics and Power Institute). High Temp. 11: No. 6, 1103-1107 (July 1974).

The results are given from measurements of the flow and wall temperatures of a coolant flowing in a pipe in the transition from convective single-phase heat transfer to heat transfer with the surface boiling of water in a vertical circular pipe. The radical and lengthwise temperature distributions in the flow are investigated, along with the statistical characteristics of the temperature fluctuations in the surface boiling zone. (auth)

26714 ANALOGY OF HEAT- AND MASS-TRANSFER PROCESSES IN VAPOR CONDENSATION FROM A VAPOR-GAS MIXTURE. Bobe, L.S.; Mayshev, D.D. (Moscow). High Temp. 11: No. 6, 1108-1112 (July 1974).

The authors investigate the analogy of transfer processes in the presence of mass flow in application to the condensation of vapor from a vapor-gas mixture. The feasibility of using the well-known equations characterizing friction and heat-transfer processes on a permeable plate to describe the relative variation of the mass-transfer coefficients associated with diffusion mass flow at the surface is demonstrated. The experimental data of the authors and several other researchers corroborate the results of the study. (auth)

26715 CALCULATION OF HEAT TRANSFER IN THE SINGLE-PHASE, NEAR-CRITICAL REGION IN THE CASE OF A VISCOSITY-INERTIA-GRAVITY FLOW. Ikryannikov, N.P.; Petukhov, B.S.; Protopopov, V.S. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 11: No. 5, 949-955 (May 1974).

Generalizing relationships are given for calculating heat transfer in the near-critical region of the state parameters in the case of the combined effect of forced and free convection. The relationships were obtained for lifting and subsidence motion of the fluid in a vertical pipe for $x/d > 20$ under conditions of heating. For lifting fluid flow a method is proposed for calculating the wall temperature in the pipe section $x/d < 20$. (auth)

Materials Testing

Refer also to abstracts 27417 and 27456.

26716 (UCID-15949) LOCATING GAS-BLOCK PLUGS IN CANNIKIN EVENT CABLES. Prevo, C. T.; Hodgkins, D. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Nov 1971. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

At some past underground events, signal cables have apparently provided a path for radioactive gases to reach the surface. In order to contain these gases, it is important that the cables have effective gas blocks. The ⅞-in. foam HELIAX cable has an aluminum outer conductor and a copper tube inner conductor. In the manufacturing process rubber plugs (0.3×1.5 in.) are placed in the copper just as it is formed into a tube. Inside the copper tube the rubber plug has the dimensions of 0.25×2.0 in. and a density of about 1.2 g/cc. To assure the presence of these gas blocks, scanning and radiographing methods were developed to nondestructively locate the rubber plugs which form the gas blocks in foam HELIAX cables to be used for the Cannikin Event. The system consisting of a radioactive source, NaI detector, photomultiplier tube and counting electronics is described. (TFD)

26717 COMPUTERIZED ULTRASONIC INSPECTION OF REACTOR VESSELS. Honeycutt, C. R. (Babcock and Wilcox Construction Co., Copley, OH); Sattler, F. J.; Williams, L. P.; Griffith, E. G. Mater. Eval.; 32: No. 9, 181-186(Sep 1974).

From 7th international conference on nondestructive testing; Warsaw, Poland (4 Jun 1973).

An automated ultrasonic inspection system for reactor vessels employing computer scanning, data acquisition, data storage and analysis has been designed, constructed and evaluated. This system consists of two basic components: a manipulator and controller. The manipulator contains transducers, gear drives and encoders to provide remote ultrasonic inspections of vessel welds from the internal wall of pressurized water reactor vessels. The controller contains two high-speed minicomputers that automatically position the inspection transducers and scan the vessel weld zones, recording and analyzing ultrasonic indications. The data are processed and analyzed in real time and can be used for comparison at a later time. Data from preoperational testing (before critical operation) are recalled from magnetic tape and compared with current inspection results. Current data are compared with baseline data and any differences are presented on a cathode ray tube display and hard copy matrix printer, and the new data are stored on magnetic tape. The manipulator heads operate in pulse-reflection, with straight beam longitudinal wave inspection and angle beam shear or longitudinal waves. A monitoring function has been designed into the system to observe the penetration of angle beams and measure the amplitude reflected from the external surface. Provisions have also been made for the performance of pitch-catch and delta inspections. Various features of the ultrasonic and computer systems are described. (auth)

26718 DETERMINATION OF THE TEMPERATURE FIELDS OF TURBINE DISKS AND BLADES BY IRRADIATED DIAMOND INDICATORS. Barbashin, E. F.; Pul'kis, K. S.; Nikolaenko, V. A. Strength Mater. (USSR) (Engl. Transl.); 5: No. 8, 1023-1026(Aug 1973).

Translated from Probl. Prochnosti; 5: No. 8, 117-119(Aug 1973).

A thermometric method is described that uses irradiated diamond indicators without the use of current collectors. In addition to a considerable savings of time and simplification of design and experimental work on thermometry, the indicator makes possible a detailed measurement of the temperature fields by simultaneous recording of the temperatures at many points. Along with this, thermometry by irradiated diamond indicators has a slightly smaller measurement error, about ±1.5%. The indicated method of measuring steady temperature fields is based on the property of crystalline diamond to increase the volume of the crystal when irradiated by high-energy particles and to recover its original volume when heated. In particular, in the case of integral fluxes of 10^{21} fast neutrons/cm^2 and irradiation temperature of 100°C the expansion exceeds 5%. On heating the irradiated diamond gradual recovery of the original dimensions of the lattices, ending at a temperature of more than 1200°C, occurs. The indicators are made of AM-20 natural diamond powder which is irradiated in a reactor in a flow of 5×10^{19} to 5×10^{20} n/cm^2 at 100°C. (After irradiation the diamond is practically nonradioactive, with permits working without special precautionary measures.) Then 1 to 2 mg og the irradiated diamond powder is poured into a stainless steel capsule with an outside diameter of 1 mm and length to 5 mm which is closed with a plug and sealed. The indicator is inserted into a hole drilled in the temperature measurement zone and the hole is closed with the bore core or covered by a foil platelet welded about the contour of the hole. (auth)

Nuclear Explosions

Refer also to abstracts 26784, 26962, 26970, 26976, and 26977.

26719 (AD-773048) MINIMIZING DAMAGE TO REFINERIES FROM NUCLEAR ATTACK, NATURAL AND OTHER DISASTERS. Stephens, M. M. (Office of Oil and Gas, Washington, D. C. (USA)). Feb 1970. Contract DAHC20-68-C-0097. 256p. NTIS $6.50.

The object of this publication is to review with refinery management and technical personnel: (1) the nature of the possible damage to installations and to people caused by hurricanes, tornadoes, fires, floods, or earthquakes, and the similarity of such forces to those created by nuclear weapons; (2) the probable extent and magnitude of the destruction resulting from a blast or natural disaster;

(3) the research done by government and related agencies and industry which points out ways to strengthen a modern oil refinery to make it more damage and blast resistant within the realm of economic judgment; and, (4) other problems to be expected in time of war. (GRA)

26720 (AD-773320) NORSAR RESEARCH AND DEVELOPMENT, 1 JULY 1972–30 JUNE 1973. Husebye, E. S. (Norges Teknisk Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). 1 Nov 1973. Contract F19628-70-C-0283. 47p. (NORSAR-63; ESD-TR-73-356). NTIS $3.25.

The report covers the period 1 July 1972 to 30 June 1973 which is characterized by continuous improvements in event detection and location performance during routine operation of the array. The research efforts were aimed at improving the event detectability, and the potential exploitation of wave scattering effects for improving NORSAR's event detection and classification capabilities. Work completed and in progress is presented. The first section deals with seasonal and diurnal noise level fluctuations plus changes in the character of the noise. Next, different types of array beamforming and optimum signal estimation techniques are discussed. The importance of so-called intrinsic time and amplitude anomalies or wave scattering (Chernov) effects in array data processing are also demonstrated. Finally, work on seismic verification problems is discussed briefly. (auth)

26721 (AD-773323) INTERPRETATION OF STRONG-MOTION EARTHQUAKE ACCELEROGRAMS USING A MOVING DISLOCATION MODEL. Semiannual Technical Report No. 3, 1 May–30 October 1973. Turnbull, L. S. Jr.; Battis, J. C. (Texas Instruments, Inc., Dallas (USA)). 15 Nov 1973. 51p. NTIS $3.75.

Near-field strong-motion accelerograms of the San Fernando earthquake and three of its aftershocks recorded at Pacoima Dam were analyzed using Haskell's moving dislocation model. For the main shock, it was found that: (1) the effect of stickslip (segmented rupture velocities) is not prominent within a moderate range of rupture velocities; (2) a hinged fault surface can produce the necessary initial negative polarity of the vertical velocity trace; and (3) using Jungles' and Frazier's (1973) solution, the Haskell model produces very large amplitudes compared to those observed. (auth)

26722 (AD-773915) SIMULATION FOR THE ASSESSMENT OF TACTICAL NUCLEAR WEAPONS (SATAN II). General Description. Change 1. Computer System Manual. Lautzenheiser, M. W.; Bales, W. B.; Fletcher, N. W.; Bales, W. B.; Fletcher, N. H.; Eoff, E. A.; Koehler, R. B. (National Military Command System Support Center, Washington, D. C. (USA)). 17 Jan 1974. 17p. (NMCSSC-CSM-GD-133-72-1). NTIS $3.00.

The manual describes briefly the Simulation for the Assessment of TActical Nuclear Weapons (SATAN II). The SATAN 2 simulation is a model for the two-sided, open play of a tactical nuclear weapons conflict on simulated battlefields. When provided by the user with the required input data, the SATAN 2 computer programs will automatically deploy forces; acquire targets; allocate nuclear weapons to fire on those targets; assess the effects of those fires; perform counter-battery operations; and, interface with A Tactical, Logistical, and Air Simulation (ATLAS). The SATAN 2 Model is programmed in FORTRAN 4 for use on the IBM 360/50/65 computer. (auth)

26723 (AD-774027) COMPRESSIONAL WAVE POWER SPECTRUM FROM SEISMIC SOURCES. Report for 30 June 1972–29 June 1973. Noponen, I. (Helsinki Univ. (Finland)). 31 Oct 1973. 81p. (AFOSR-TR-74-140). NTIS $4.00.

The power spectra of P wave signals were studied. Data from the 22 long period (LP) and short period (SP) sensors of the NORSAR array in Norway were used. For each type of sensor, the signals from all sensors were combined in an optimum way to produce average LP and SP spectra. Bias due to noise power was removed, the instrument responses were corrected for and the LP and SP spectra merged together. About 150 events were treated, of these the LP signals were analyzed for about 20 events. The earthquake and explosion spectra agree well with the predictions of analytical source models. (auth)

26724 (AD-774152) METHOD FOR ESTIMATING THE X-RAY PRODUCED ELECTROMAGNETIC PULSE OBSERVED IN THE SOURCE REGION OF A HIGH-ALTITUDE BURST. Higgins, D. F.; Longmire, C. L.; O'Dell, A. A. (Mission Research Corp., Santa Barbara, Calif. (USA)). 29 Nov 1973. Contract DASA01-71-C-0105. 39p. NTIS $3.25.

A method for estimating the x-ray produced EMP fields seen by an observer inside the high-altitude source region is discussed. The electric field is assumed to be primarily radial; thus the time rate of change of this radial field is directly proportional to the total current density. The current density is divided into two parts. The primary current is produced by the high-energy photoelectrons created by the x-ray flux of the weapon. The secondary current is due to the low-energy ionization electrons. A swarm theory treatment relating the average electron energy, number density, and drift velocity is used to deal with these low-energy secondaries. As a net result, five coupled differential equations are obtained which must be solved to find the radial electric field. (auth)

26725 (AD-774457) COMPARISON OF THE LOCATION REFINEMENT TECHNIQUES IN THE SDAC/LASA EVENT PROCESSOR. Ahner, R. O. (Teledyne Geotech, Alexandria, Va. (USA)). 9 Oct 1973. 46p. (SDAC-TR-73-5). NTIS $3.25.

The two location refinement techniques, beam-packing and cross-correlation, which are programmed into the SDAC/LASA automated Event Processor, are shown to produce equivalent array beam traces for LASA short period data. The crosscorrelation method requires an operational signal-to-noise threshold significantly above the SDAC/LASA detection threshold of 10 db. In addition, the method yields unreliable locations for events with low coherence, such as events with low signal-to-noise ratios, mixed events, or events at short epicentral distances from the array. On the other hand the beampacking method is independent of signal-to-noise ratio. Moreover, beampacking uses 15 to 20% less computer time than crosscorrelation and obtains locations with smaller location errors when compared to Worldwide Network locations. (auth)

26726 (AD-774458) LASA REGIONAL TRAVEL-TIME CORRECTIONS AND ASSOCIATED NODES. Chiburis, E. F.; Ahner, R. O. (Teledyne Geotech, Alexandria, Va. (USA)). 9 Oct 1973. Contract F08606-74-C-0006. 36p. (SDAC-TR-73-6). NTIS $3.25.

A new set of region corrections has been generated for LASA which more adequately covers the seismically active area of the earth than did previous sets. The new set contains 183 calibration nodes versus 105 nodes on the set used in the SDAC/LASA system throughout 1972 and the first half of 1973. Each mode contains the average relative travel-time anomalies for each of the 21 subarrays at LASA which are valid over an area surrounding the location of the node. The corrections were generated from more than 1800 events using as a primary source of data the time shifts resulting from the crosscorrelation process in the SDAC/LASA Event Processor. (auth)

26727 (AD-774620) SIMULATION FOR THE ASSESSMENT OF TACTICAL NUCLEAR WEAPONS (SATAN II). Programming Specification Manual. Lautzenheiser, M.; Bales, W. B.; Seefeldt, C. D.; Fletcher, N. H.; Eoff, D. A. (National Military Command System Support Center, Washington, D. C. (USA)). 15 Sep 1973. 442p. (NMCSSC-CSM-PSM-133-73). NTIS $9.00.

The SATAN 2 Programming Specification Manual (PSM) provides a detailed description for the SATAN 2 Model as implemented on the IBM 360/50/65 computer. SATAN 2, Simulation for the Assessment of TActical Nuclear Weapons, is a model for the two-sided, open play of tactical nuclear weapons on simulated battlefields. With user-provided descriptions of the engaging forces, target acquisition rates, and a nuclear employment doctrine, SATAN 2 will automatically: establish the battle area; deploy the forces; determine necessary reaction for actions taken; acquire targets; allocate nuclear weapons to fire on acquired targets; assess the effects of those fires; move the Forward Edge of Battle Area (FEBA); automatically interface with ATLAS (A Tactical, Logistical, and Air Simulation). The SATAN 2 Model is programmed in FORTRAN 4 for use on IBM 360/50/65 computers. (auth)

26728 (AD-774984) QUARTERLY TECHNICAL SUMMARY REPORT, OCTOBER–DECEMBER 1973. Hartenberger, R. A. (Teledyne Geotech, Alexandria, Va. (USA)). 15 Jan 1974. Contract F08606-74-C-0006. 12p. NTIS $3.00.

The operations and maintenance tasks and the research work accomplished at the SDAC during the quarter ending 31 December 1973 are summarized. (auth)

26729 (AD-775388) STUDY OF THE DATA COLLECTION, PROCESSING, AND MANAGEMENT SYSTEM FOR A WORLDWIDE SEISMIC NETWORK. Final Technical Report. Briscoe, H. W. (Bolt, Beranek, and Newman, Inc., Cambridge, Mass. (USA)). 14 Sep 1973. Contract F08606-73-C-0035. 68p. (BBN-2632). NTIS $3.75.

A recommendation of a system design for a worldwide seismic data network is presented. Particular attention has been paid to recent or imminent developments in the areas of digital communication, processing, and storage. Both sensor stations currently

expected to be operational about 1975 and possible future expansion or modification of the network are considered. The major conclusions of the system design are (1) seismic event detection should be done at the array site in the majority of cases, (2) the ARPANET is generally a suitable and cost effective communication facility for seismic data transmission, (3) a communications control center should be established at SDAC in order to coordinate and monitor the seismic data network operation centrally, (4) network event processing can evolve from the existing large array event processing system at SDAC, (5) long period event processing should be done off-line using ARPANET computing resources with special consideration given to eventual use of the ILLIAC IV array processor, and (6) the Datacomputer service can provide an appropriate data management system for the seismic data network. (auth)

26730 (AD-776344) PULSER FOR EMP SIMULATION. Wright, W. H. Jr. (Army Electronics Command, Fort Monmouth, N. J. (USA)). Feb 1974. 74p. (ECEM-4198). NTIS $3.75.

The project was undertaken to provide a pulser capable of driving a low-impedance array of antennas with a high-peak-power and a short risetime pulse to simulate the electrical interference effects of an electromagnetic pulse (EMP). The final pulser produced a 100 kilovolt (kV), 72 kiloamperes (KA) output pulse with a 6 nanosecond (ns) voltage risetime and 42 ns current risetime through a single output switch. Additional experiments showed how multiple output switches could reduce the current risetime to 14 ns with a 9 ns jitter. The output switch was a water- or air-filled spark gap, and operation in both modes is described. The report also includes design information on a simple and reliable 100 kV dc switch, a low-impedance high power dummy load, and voltage and current measuring devices for viewing fast transients. (auth)

26731 (AD-776361) EXPLOSIVE SELECTION AND FALLOUT SIMULATION EXPERIMENTS NUCLEAR CRATERING DEVICE SIMULATION (Project Diamond Ore). Final Report. O'Connor, J. M.; Donlan, J. J.; Burton, D. E. (Army Engineer Waterways Experiment Station, Vicksburg, Miss. (USA)). Oct 1973. 145p. (AEWES-TR-E-73-6). NTIS $4.75.

The effects of different types of stemming, depths of burial, and geologic conditions on the crater size and collateral effects produced by the subsurface detonation of a nuclear cratering device were studied by using a combination of hydrodynamic code calculations and large-scale chemical explosive charges to model the nuclear explosive energy source. The research program also includes development of a nuclear fallout simulant. A detailed summary of the explosive selection and testing process and the development and testing of the fallout simulants are presented. (auth)

26732 (AWRE-O-28/74) COMPUTER PROGRAMS FOR EPICENTRE DETERMINATION. Douglas, A.; Lilwall, R. C.; Young, J. B. (UKAEA Weapons Group, Aldermaston, Atomic Weapons Research Establishment). Jun 1974. 108p. Dep. NTIS (U. S. Sales Only) $8.50.

Four programs for determining the epicenter (and origin time and depth where possible) of a seismic event are described: SPEEDY uses Geiger's classical method of estimating the epicenter, origin time and depth of focus of an event; SPUR is similar to SPEEDY but is more compact and hence suitable for a small machine; JED is an extension of the classical method to estimate the epicenters, origin times and depths of a large number of events and station (time) terms simultaneously; and EFA estimates epicenters, given the azimuth of an event from each of a number of stations. (auth)

26733 (CONF-730907-P2, pp 1060-1065) EVALUATION OF NUCLEAR GAS STIMULATION IN TERMS OF POTENTIAL RADIATION EXPOSURE TO THE PUBLIC. Rohwer, P. S.; Barton, C. J.; Moore, R. E.; Kaye, S. V. (Oak Ridge National Lab., TN). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Experience gained from Projects Gasbuggy and Rulison and their follow-up studies indicates that natural gas produced from a nuclearly stimulated well field will contain small amounts of man-made radioactivity as it leaves the gas processing plant and enters commercial distribution channels. Individual and population doses have been estimated for hypothetical uses of such gas. For example, it is estimated that residential use of nuclearly stimulated gas in unvented cook stoves would result in an average total-body dose to the house occupants of approximately 0.2 millirem/year. Radon concentrations measured in natural gas at various locations in the United States average approximately 20 pCi per liter. Assuming this concentration of radon in the unvented cooking case mentioned, the lung dose is estimated to be 1.5 millirems per year. All of the dose estimates discussed are used to give perspective to the additional radiation exposure of the public which could occur due to use of gas from nuclearly stimulated wells. Both somatic risk and genetic risk are considered in the assessment of relative hazard. Comparisons are made with other risks encountered in the normal activities of life in the United States. The studies summarized show that the radiological impact of either domestic or industrial use of the gas can be small. (auth)

26734 (PB-231012) PLOWSHARE TECHNOLOGY ASSESSMENT. Seismic Effects. Busch, R. D.; Whan, G. A. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Jul 1973. 46p. (NSF/RA/G-73-017). NTIS $3.25.

Results of a study conducted to summarize and evaluate current theoretical and experimental analyses of the environmental effects of ground motion from underground nuclear explosions are presented. Effects on geological formations, buildings, and surface structures, as well as ecological impacts are discussed. (auth)

26735 (PB-231014) PLOWSHARE TECHNOLOGY ASSESSMENT LEGAL STUDIES. Volume I. State Power Over Plowshare: Constitutional Framework, and Pre-Emptive Capability of Federal Power. Engdahl, D. E. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Mar 1973. Contract NSF-GT-21. 139p. (NSF/RA/G-73-019) NTIS $4.75.

An analytical overview is presented of the constitutional principles that support the power of states to control peaceful nuclear explosive activities in the United States notwithstanding the operational involvement of the United States Atomic Energy Commission in such activities. A more extended and more fully documented examination of the capability and incapability of various federal regulations and activities to pre-empt regulatory controls and policy determinations of the states is also described. The need for ascertaining the pre-emptive capability of a particular federal regulation or activity before the effect of pre-emptive federal intent can be assessed is examined. (GRA)

26736 (PB-231015) PLOWSHARE TECHNOLOGY ASSESSMENT LEGAL STUDIES. Volume II. State and Federal Power Over Federal Property. Engdahl, D. E. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Mar 1973. Contract NSF-GT-21. 233p. (NSF/RA/G-73-019A). NTIS $6.00.

The report gives a detailed historical and analytical examination of the evolution and present status of constitutional principles governing the power of states and of the United States over federally-owned property, tracing the sources of the intellectual confusion that has made this a complicated and widely misunderstood branch of constitutional law. The origin and development of doctrine under both Article I, Section 8, Clause 17, and Article IV, Section 3, Clause 2 are examined. In the light of contemporaneously evolving principles on other aspects of constitutional law, in order to expose the premises and points of probable future modification of modern property clause doctrine. The currently prevailing notions as well as the likely future developments with respect to state and federal power over federal property are analyzed and discussed. (GRA)

26737 (PB-231016) PLOWSHARE TECHNOLOGY ASSESSMENT LEGAL STUDIES. Volume III. Deficiencies of Price-Anderson Protection for Plowshare, and Other Legal Papers. Engdahl, D. E.; Olpin, O.; Firmage, E. B. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Mar 1973. Contract NSG-GT-21. 69p. (NSF/RA/G-73-019B). NTIS $3.75.

The report contains four papers discussing the applicability of the Price-Anderson Amendment of the Atomic Energy Act to damages from peaceful applications of nuclear explosives; a possible different system for citizen redress for damages caused by such applications of nuclear explosives; and the international law ramifications of utilization of peaceful nuclear explosives technology in the United States. (GRA)

26738 (PB-231017) PLOWSHARE TECHNOLOGY ASSESSMENT. Public Participation (with Reference to Nuclear Stimulation of Natural Gas). Gahin, F. S. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Jan 1973. 124p. (NSF/RA/G-73-020). NTIS $9.25.

Several aspects of nuclear stimulation of natural gas including risk analysis of ground motions and radiation risk, impact of local communities, legal and statutory problems, insurance and government indemnity, dissemination of public information and public participation methods in the decision-making process are pre-

sented. A published article on legal liability and insurance in nuclear stimulation of natural gas is also included. (GRA)

26739 (PB-231037) PLOWSHARE TECHNOLOGY ASSESSMENT. Nominal Seismic Effects. Bellamy, J. C.; Brewer, R. E. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Aug 1972. Contract NSF-GT-21. 18p. (NSF/RA/G-73-016). NTIS $4.00.

Perspectives concerning the possible seismic effects of deep underground nuclear explosions are provided by relating them to the energies, intensities and magnitudes of natural earthquakes and to the provisions of the uniform building code. Toward this end the typically representative relationship between seismic intensities and explosive energies is derived. It clearly shows that the seismic energy of such explosions is several orders of magnitude less than that of destructive earthquakes, and that only minor structural damage is to be expected from deep potentially-useful explosions with yields up to about that of 100 kt of TNT. (auth)

26740 (PB-231038) PLOWSHARE TECHNOLOGY ASSESSMENT. Material Resources Analysis. Bell, P. A.; Whan, G. A. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Jan 1973. Contract NSF-GT-21. 34p. NTIS $4.75.

The supply of special nuclear material for nuclear explosives might prove to be a limiting factor in the commercial implementation of nuclear stimulation of natural gas. An analysis of energy and material resources for nuclear gas stimulation and some of the factors which might influence the successful application of this technology are presented. (GRA)

26741 (PB-231039) PLOWSHARE TECHNOLOGY ASSESSMENT. Energy Development Trends. Bellamy, J. C.; Penz, M. C. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Jan 1973. Contract NSF-GT-21. 29p. (NSF/RA/G-73-013). NTIS $4.50.

An analysis of probable future needs for energy in relation to potential sources of energy and environmental concerns is used to postulate how those needs might best be served. It is thereby postulated that nuclear heating plants can be developed to serve most of our needs for heat and electrical energy in stationary locations, and that fossil fuels can be conserved largely for propelling vehicles. It is also seen that nuclear explosives are likely to be needed to extend the use of natural gas for stationary heating needs during the transitional period. (auth)

26742 (PB-231040) PLOWSHARE TECHNOLOGY ASSESSMENT. Seismic Damage Compensation. Maxwell, L. C.; Jenabzadeh, H. (Western Interstate Nuclear Board, Lakewood, Colo. (USA)). Jun 1972. Contract NSF-GT-21. 16p. (NSF/RA/G-73-021) NTIS $4.00.

The community in an area surrounding nuclear explosions suffers certain risks and costs from the ground motion resulting from nuclear blasts, such as evacuation and inconvenience to residents, interruptions of public activities, and damage to public property. A method whereby the community can be compensated for these costs by a permit fee which is negotiated between the business enterprise using the nuclear explosives and the local governments involved is presented. Compensation from the negotiated permit fee for certain costs incurred would increase the revenue which is available to the local governmental units in the community. The use of a negotiated permit fee would also allow the residents surrounding the nuclear explosion to become active participants in the decision-making process. (GRA)

26743 (UCID-4958) LEACHING OF COPPER ORES AND THE USE OF BACTERIA. Rabb, D. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Jan 1965. 34p. Dep. NTIS $4.75.

After a brief description of the use of nuclear explosives to shatter or break ore bodies (Hardhat Event), the in-situ leaching of copper ore deposits is discussed. Recent laboratory tests are discussed that indicate special cultured autotrophic bacteria can speed the oxidation and boost the extraction of copper from recalcitrant sulfides to many times that achieved in sterile control samples or in current commercial practice. Preliminary observations were made on the effects of radiation on bacteria in an acid mine water. (TFD)

26744 (UCID-15460) SOME OBSERVATIONS ON THE ASYMMETRICAL GROWTH IN THE VERTICAL DIRECTION OF THE PILE DRIVER CAVITY. Preston, R. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1969. 11p. Dep. NTIS $4.00.

Experimental measurements of the stress wave vertically above Pile Driver and Hard Hat indicate that Cherry and Rapp in their code calculations (UCRL-50373) of the growth of the Pile Driver cavity ascribed too early an arrival at the cavity roof for the tension wave reflected from the free surface. However, earlier arrivals, possibly comparable to that ascribed in their calculation, may have resulted from reflections at the base of a layer of weathered material. Lacking information on the physical properties of this layer, its role in accelerating the growth of the cavity cannot be determined. Thus, it is not clear, without additional data and new calculations, whether the unusually large cavity formed in Pile Driver can still be attributed to significant acceleration of cavity growth by the tension wave reflected from the free surface. Since Rapp has used the Pile Driver calculation as a basis for advocating shallower depths of burst in testing nuclear devices, it is recommended that Pile Driver be recalculated, incorporating not only data available from stress wave measurements surrounding the shot but also data which may be acquired from exploratory drilling into the weathered layer and into the cavity. A new hole is now being drilled for this purpose, and data from the measurements made in it will be reported. (auth)

26745 (UCID-15464) ELIMINATION OF 500 MHz FEED-THROUGH. Somer, G. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Mar 1969. 9p. Dep. NTIS $4.00.

Separating noise from data is one of the biggest problems that reaction history engineers have to deal with each time they set up a new diagnostic system. A unique method is described which, if used properly, will eliminate 500 MHz feed-through from any 3344 scope and thus significantly improve the quality of the data. The term "500 MHz feed-through" refers to the 500 MHz noise which appears on the signal cables in an alpha diagnostics station whenever a 500 MHz Rossi system is employed. Presently, the feed-through is filtered out of the data numerically. However satisfactory this method may be, it would be more advantageous if the problem could be eliminated at the sources. (auth)

26746 (UCID-15783) ONE-DIMENSIONAL (SOC) CALCULATIONS OF THE EFFECTS OF FOUR NUCLEAR EVENTS IN ALLUVIUM. Hearst, J. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jan 1971. Contract W-7405-eng-48. 52p. Dep. NTIS $5.75.

An empirical equation of state for Yucca Flat alluvium has been developed. This equation was used in the one-dimensional SOC code to calculate effects of four underground nuclear explosions—Hupmobile, Packard, Vulcan, and Merlin—and good agreement was obtained with measured peak particle velocity vs radius, expected crushed radius vs time, and measured cavity radius. Agreement with particle velocity pulse shape was not very good, and agreement with measured reduced displacement potential was unclear. (auth)

26747 (UCID-15791) PERMEABILITY OF NTS ALLUVIUM: NUMERICAL SIMULATION OF AIR-INJECTION EXPERIMENTS. Rozsa, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Feb 1971. 18p. Dep. NTIS $4.00.

The gas flow properties of the medium surrounding an underground emplaced nuclear device are important in evaluating potential containment problems. The presence of faults or large cracks is significant in that if early gas flow is turbulent enough, erosion will result and the flow path will widen. This, together with the high driving pressure available before chimney collapse, can result in large quantities of gas being vented. Even when early-time dynamic venting is not a problem, late-time seepage can result if the permeability is high enough and the source pressure remains above ambient pressure for a long period. To study the flow of gas through NTS alluvium, air-injection experiments were conducted in September 1969. A 454-ft-deep hole, U-10am-5, was used. This report describes attempts to fit the experimental data with numerical calculations using a one-dimensional radial flow model. Results are presented which agree with the experimental data, but no unique values of permeability and porosity are evident. Because of the form and small amount of experimental data available, no conclusion can be made on the validity of the one-dimensional flow model. The numerical calculations show that most of the field experiments are transient over long periods of operation time, and recommendations are made that future field measurements reflect this. (TFD)

26748 (UCID-15905) OPERATION CANNIKIN: ESTIMATED SURFACE GROUND MOTION EFFECTS. Jackson, E. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1971. 13p. Dep. NTIS $4.00.

Estimated peak surface ground motion data on Amchitka Island during the Cannikin event are summarized. These estimates are for structural design purposes and are therefore slightly conservative. Milrow results and observations are listed and discussed

in comparison with Cannikin estimates. Effects of estimated ground motion on various facilities at Amchitka are being reviewed. (TFD)

26749 (UCID-16002) MULTIPROJECT SCHEDULING FOR THE WORLD'S LARGEST JOB SHOP. Steres, G. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Mar 1972. Contract W-7405-eng-48. 24p. Dep. NTIS $4.25.

The allocation of scarce resources is a problem for all organizations. A nuclear research laboratory such as the University of California's Lawrence Livermore Laboratory (LLL) is no exception. One of the areas in which the Laboratory directly confronts the problem of resource allocation is in the scheduling of underground nuclear tests at the Nevada Test Site (NTS). The 1500 square mile Test Site is perhaps the world's largest job shop. As with any job shop, NTS has a fixed (at least in the short run) set of resources with which it produces the end product. The product, in this case, is an underground nuclear test, known at LLL as an "event". Like other job shops there are no long production runs: the quantity per order is one. While other job shops may speak of "operations" such as milling, events consist of "activities" such as site preparation. A method of determining the optimal schedule for this largest of job shops is described. (auth)

26750 (UCID-16008) NUCLEAR SOLUTION MINING. Part VIII. Oxygen Distribution. Braun, R. L.; Lewis, A. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1972. 32p. Dep. NTIS $4.75.

In solution mining of copper ores that have been fractured by nuclear explosions it is important that a relatively high dissolved oxygen content be achieved in as much of the chimney solution as possible. This study indicates that adequate dissolution of oxygen and circulation of the oxygenated solution can be obtained even if only one perforated oxygen line across the bottom of the chimney is used. This is accomplished, however, at the expense of venting a considerable fraction of the input oxygen as undissolved gas passing out of the chimney. The use of more input gas lines not only decreases this vent fraction, but gives added assurance that, if solution circulation problems arise, a large fraction of the chimney solution will still be adequately oxygenated. Therefore, it is recommended that three input gas lines be used, giving the following results (conservatively based on a high oxygen consumption of 5×10^3 g/s and a large oxygen bubble radius of 1 cm): (1) degree of oxygen saturation = 0.61; (2) fraction of chimney solution in non-bubble region = 0.65; (3) ratio of oxygen circulation rate to oxygen dissolution rate = 0.64; and (4) fraction of input oxygen which passes through chimney without dissolving = 0.50. These estimates are conservative, since at oxygen consumption rates lower than 5×10^3 g/s the desired circulation and dissolution rates can be achieved with even lower vent fractions or, alternatively, fewer than three input lines could be used. Oxygen consumption rates greater than 5×10^3 g/s in a single chimney are not anticipated. In addition, the above estimates are conservative, since for a smaller and possibly more realistic initial gas bubble radius of 0.5 cm, a higher degree of saturation (0.84) and a lower vent fraction (0.20) are obtained in achieving the desired circulation/dissolution ratio of 0.65 for three input lines. (TFD)

Protective Structures and Equipment

26751 (CEA-CONF-2596) MODERN METHODS OF EVALUATING THE SAFETY OF PRESSURIZED APPARATUS. Roche, R. (Grenoble-1 Univ., 38 (France)). [nd]. 49p. (In French). (CONF-740128-1). Dep. NTIS (U. S. Sales Only) $5.50.

From conference on the actualization of the concept of safety in mechanical constructions; Paris, France (6 Jan 1974).

A review is given of the concepts governing the evaluation of the safety of pressurized apparatus. Damage statistics and risks are defined. The evolution of dimensioning methods is outlined. The types of destruction are then described. These include excessive deformation, plastic instability, elastic or elasto-plastic instability, progressive deformation, fatigue fissures, and abrupt rupture. Each of these is analyzed and the conditions leading to their occurrence are indicated. (JSR)

26752 ADSORBENT FOR RADIOIODINE AND METHYL IODIDE CAPTURE IN FILTER UNITS AND FOR RADIOIODINE DETECTION IN NUCLEAR POWER PLANTS. Hladky, E.; Pietrik, I. Czech Patent 147,362. 21 Jan 1972. 2p. (In Czech).

A technique is proposed for preparing an adsorbent by impregnation of alumina with silver nitrate. Testing of the resulting adsorption properties is described. The mean adsorption efficiency was found to be greater than 99.9% for radioiodine, and 99.8% for methyl iodide. The permeability of the adsorbent was studied for krypton and xenon. The adsorption efficiency was investigated in the temperature range of 25 to 200°C and found to be constant over this range. (INIS)

Safety Engineering

Refer also to abstracts 27100 and 27114.

Vacuum Engineering

Refer also to abstract 28111.

26753 HIGH VACUUM INSTALLATION WITH OILLESS PUMPING SYSTEM. Yanov, A. E.; Papakin, V. F.; Bagrov, N. N.; Shtitel'man, O. B.; Grinenko, N. S. Kriog. Vak. Tekh.; No. 2, 30-32(1972). (In Russian).

The construction of a high vacuum installation with oilless pumping system is described and its test results are reported. The installation was provided with a system for the throughput of liquid helium through the coils of diffusion and cryosorption pumps. The ultimate vacuum in the chamber is attained by the subsequent operation of membrane, forevacuum sorption, and high-vacuum sorption pumps cooled by liquid nitrogen and by diffusion and cryosorption pumps cooled by gas-liquid mixtures of helium. The analysis of the residual gas was done by a radio-frequency single mass spectrometer ROMS-I. During different operating regimes of the installation oil traces were not detected. The heaviest mass registered in the chamber during pumping was 44 (CO_2). Only He peaks were registered at the ultimate vacuum of the chamber of 1 to 2×10^{-9} torr. (tr-auth)

26754 ULTRAHIGH VACUUM INSTALLATION CVVK-100 WITH EFFECTIVE VOLUME OF 100 L WITH CRYOGENIC PUMPING SYSTEM. Yanov, A. E.; Korotov, Yu. P.; Bagrov, N. N.; Grinenko, N. S. Kriog. Vak. Tekh.; No. 2, 27-29(1972). (In Russian).

An ultrahigh vacuum installation was constructed in which pressures below 1×10^{-12} torr were obtained by cryogenic pumps. A pressure of 1×10^{-11} torr was obtained by cooling the surface of the working chamber to 80°K. The construction of the installation made it possible to work with significant thermal loads on objects and, by removal of the internal radiation screen, to increase significantly the pumping rate of the cryogenic pumps for objects with low heat release. A temperature control device was developed which makes it possible to expand the range of materials and articles studied. It eliminates the heating of objects during testing in the heated chamber and maintains the chamber temperature with sufficient precision within the given limits. (tr-auth)

26755 ULTRAHIGH VACUUM OILLESS PUMPING ASSEMBLY. Godovannyi, V. A.; Bagrov, N. N.; Yanov, A. E.; Maslii, L. G.; Terpigor'ev, E. N.; Kostin, Yu. K. Kriog. Vak. Tekh., No. 2, 33-33(1972). (In Russian).

An ultrahigh vacuum oilless pumping installation was designed for the development of methods of obtaining a sterile vacuum. It consists of diaphragm pumps, adsorption pumps cooled by liquid nitrogen, and an ultrahigh vacuum assembly containing two condensation-adsorption pumps cooled by liquid helium. Experiments with the assembly showed that it is possible to obtain pressures lower than 10^{-10} torr. The spectra of the residual gases at different stages of evacuation were reported. (tr-auth)

ENVIRONMENTAL AND EARTH SCIENCES

26756 USE OF PRIMARY ENERGIES SO AS TO PRESERVE THE ENVIRONMENT–A TASK FOR THE ELECTRICITY SUPPLY INDUSTRY. Trenkler, H. (Vereinigung Deutscher Elektrizitaetswerke e.V. (VDEW), Frankfurt am Main (F. R. Germany). Fachausschuss Kraft- und Waermewirtschaft). Elektrizitaetswirtschaft; 73: No. 11, 287-293(May 1974). (In German).

From European conference on electrotechniques; Amsterdam, Netherlands (22 Apr 1974). 16 figs.; 2 tabs.; 18 refs.

The order of magnitude of the contribution of the electricity supply industry to air pollution and developments to be expected are considered. It is demonstrated that the promotion of electricity consumption gives at the same time a considerable contribution to reducing atmospheric pollution, even without expensive additional measures at power stations. This fact, together with the use of pollutant emission as a measure of environmental pollution, appears from the point of view of the present aim of establishing the causal principle, and from that of the effect on regulations, of importance for the draft of a new TA-Luft (Technical instructions–Air). (auth)

Minerals and Ores

Refer also to abstracts 26451, 26783, 26794, 26795, 26819–26821, 27094, 27102, 27237, and 28844.

26757 (AAEC/E-305(Report 2), pp 1-15) TOXICITY STUDIES ON AQUATIC ORGANISMS AND GRASS-SEDGE COMMUNITIES IN THE MAGELA CREEK AREA. Giles, M. S. Jun 1974.

This study was designed to establish the relative and, whenever possible, the absolute toxicities of those substances likely to be released during the mining and processing of uranium in the East Alligator River areas. The aim was to examine a range of organisms from the area, particularly fishes, and to assess their relative sensitivities to possible pollutants. (AT)

26758 (CONF-730907-P2, pp 939-944) RADON EMANATION STUDIES IN JADUGUDA URANIUM MINE. Khan, A. H.; Raghavayya, M. (Bhabha Atomic Research Centre, Bombay). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Radon gas emanating from the rock surfaces is the major source of radon in uranium mines and ventilation is the only effective means of keeping the radon levels within the acceptable limits. Quantitative estimation of the radon emanation rates is therefore essential for calculating the fresh air requirements of a working face. Measurements of radon emanation rates were carried out in laboratory and in the underground mine. In laboratory, the uranium ore sample is enclosed in a large air-tight glass container. Radon from the sample diffuses and accumulates in the air volume of the container. Samples are periodically drawn from the container and radon activities are determined. The radon emanation rate is then computed from the activities obtained at different sampling intervals. Results obtained are presented and compared with the emanation rates published elsewhere in literature. (auth)

26759 STATISTICAL STUDY OF THE TRACE ELEMENT DISTRIBUTION IN THE MAGMATIC MEMBERS OF SINGHBHUM GRANITE. Saha, A. K. (Presidency Coll., Calcutta); Lakshmipathy, S.; Sankaran, A. V.; Bhattacharyya, T. K. Proc. Indian Nat. Sci. Acad., Part A; 39: No. 3, 171-184(May 1973).

Quantitative data for 12 trace elements (Li, Ba, Ga, U, Zr, V, Cr, Ni, Cu, Sr, Mn, and Tl) in 32 granitic rocks belonging to the three magnetic phases of Singhbhum granite were studied by applying cluster analysis and R-mode factor analysis techniques. Cluster groupings obtained by (a) Ramifying Linkage Method, (b) Correlation Profile Method (both on the basis of correlation matrices), and (c) by R-mode factor analysis, are not similar in all respects. But all of them support a model of substantially different trace element distribution processes for the three different phases of granites. (MCG)

26760 DISTRIBUTION OF U IN ECLOGITES OF THE KOKCHETAV UPLIFTS AND SOME PECULARITIES OF THEIR ORIGIN. Fel'dman, V. I.; Stupnikova, N. I.; Kovalenko, V. I. (Moscow State Univ.). Geokhimiya; No. 6, 947-952(Jun 1974). (In Russian).

The distribution of U in eclogites and amphibolites of the Kokchetav Massif depends on the composition of the initial deposit and not on the degree of metamorphosis or the increase in metamorphites. Orthoeclogites and orthoamphibolites contain ½ to ⅓ as much U as paraeclogites and paraamphibolites of the same age. The dispersion of the inclusions in orthoclase is much less than in the para rocks. The U contents in the Kokchetav eclogites (0.19-0.79 g/t) is an order of magnitude higher than in the mantle material (0.005-0.098 g/t, average 0.06 g/t). The combined on geological, petrographic, and geochemical data on the eclogites show their undoubted mantle nature. The rocks considered are products of regional metamorphosis of magmatic rocks of basic composition and clay-carbonate precipitates. (tr-auth)

26761 METHOD AND APPARATUS FOR AERIAL RADIOACTIVITY SURVEYING FOR SURFACE MINERAL DEPOSITS WHICH COMPENSATES FOR THE RADIOACTIVE DECAY PRODUCTS IN THE ATMOSPHERE OF THE EARTH. Johnson, C. H. Jr.; Foote, R. S. (to Texas Instruments Inc.). US Patent 3,825,751. 23 Jul 1974. Filed Date 3 Oct 1969. 14p.

An airborne gamma ray detection system is flown over the surface of the earth at a predetermined height. The energy spectrum of gamma radiation from the surface of the earth is detected and recorded at locations spaced along the travel path of the system. The gamma radiation emanating from uranium decay products borne by the atmosphere of the earth is also sensed and recorded with sufficient regularity to detect naturally occurring variations therein. The gamma radiation data detected from the surface of the earth is then corrected in order to reduce the inaccuracies created by the gamma radiation sources present in the atmosphere. (Official Gazette)

Radioactive Effluents

Refer also to abstracts 26328, 26514, 26515, 26523, 26757, 26758, 26778, 26779, 26785, 26819, 26821, 26836, 27082, 27104–27106, 28741, and 28771.

26762 (BNL-18773) RADIOACTIVE EFFLUENT RELEASES AND THE PUBLIC ACCEPTANCE OF NUCLEAR FACILITY SITES. Hull, A. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 11p. (CONF-740907-2). Dep. NTIS $4.00.

From symposium on the siting of nuclear facilities; Bordeaux, France (2 Sep 1974).

Arguments within the U. S. scientific community related to the public health hazards of radioactive wastes from nuclear power plants are reviewed. (LCL)

26763 (BNWL-B-333) RADIOLOGICAL IMPACT OF A NUCLEAR CENTER ON THE ENVIRONMENT. Soldat, J. K. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-1830. 19p. Dep. NTIS $4.00.

The potential radiological impact of a conceptual Nuclear Energy Center (NEC) on the environment is discussed. Principal attention is directed to the estimated radiation doses received by man. Experience at operating nuclear facilities has shown that, barring unusual circumstances, regulation of radiation doses received by man to levels consistent with currently accepted guidelines will ensure that the doses to other biota are inconsequential. The discussion addresses, in a generic sense, the routine release rates of radionuclides from fuel fabrication plants, nuclear reactors, reprocessing plants and interim waste storage facilities associated with such a NEC. The radiation doses resulting from such releases are summarized briefly, but details of the dose calculations are not presented. Further analysis of the potential radiological impact will have to be undertaken once a specific site is chosen. Depending upon the actual site characteristics, the radiological impact could be different than derived here for the generic site, but in all probability the net impact would not be significantly greater because of the conservative assumptions employed. (auth)

26764 (CONF-730907-P1, pp 260-265) MIGRATION OF RADIOACTIVE NUCLIDES UNDER DIFFERENT HYDROGEOLOGICAL CONDITIONS. Belitskii, A. S.; Orlova, E. I.; Zhakov, Yu. A.; Chelysheva, R. A.; Smirennaya, V. A.; Kruglov, V. P. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Various methods for storage of radioactive liquid wastes from atomic power stations are discussed. The conditions for under-

ground transport of radioactive contamination as a result of unsealing of radioactive waste reservoirs are considered. An assessment of radionuclide migration in soils as a factor of different hydrological conditions is included. (auth)

26765 (CONF-730907-P1, pp 291-295) MEASUREMENTS OF THE DISPERSION OF GASEOUS RADIOACTIVE EFFLUENTS FROM AN OPERATING BOILING WATER REACTOR. Carey, W. M.; Battist, L.; Keene, W. E. (American Environmental Control Systems, Inc., Gaithersburg, MD). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Measurements of off-site concentrations of the radioactive gaseous effluents from a BWR were correlated with measured meteorological parameters to define plume behaviour at a coastal site. Average ground concentrations were found to be in the 10^{-9} μCi/cc range, while peak values were observed as high as 10^{-7} μCi/cc. The data indicates that sea breeze fumigation and noctural fanning conditions significantly affect dispersion characteristics. (auth)

26766 (CONF-730907-P1, 296-300) ATOMIC ELECTRIC POWER STATIONS AS SOURCES OF CARBON-14 DISCHARGE. Rublevskii, V. P.; Zykova, A. S.; Turkin, A. D. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Carbon-14 is produced in nuclear reactors by neutron reactions in ^{14}N, ^{17}O, and ^{13}C. The expanding use of nuclear reactors for power production will contribute additional amounts of ^{14}C to the existing background levels due to atmospheric testing of nuclear devices and natural production by neutrons in upper atmosphere. The problem of environmental ^{14}C contamination from increasing utilization of nuclear reactors for power production is discussed. The experimental data on production of ^{14}C at different types of nuclear power stations in the USSR are presented. It is concluded that future production of ^{14}C from nuclear power stations will be approximately 12,000 Ci/day by the year 2010. The ^{14}C concentration in the terrestrial biosphere will reach 1050 per cent of its natural level by this year. These estimates are compared with existing equilibrium levels of naturally occurring ^{14}C and with the decreasing inventory of ^{14}C from atmospheric nuclear tests. (auth)

26767 (CONF-730907-P1, pp 301-307) SAFE DISPOSAL OF LIQUID RADIOACTIVE WASTES FROM THE UNITED KINGDOM NUCLEAR POWER PROGRAMME: A CURRENT VIEW OF THE ENVIRONMENTAL SITUATION. Mitchell, N. T. (Fisheries Radiobiological Lab., Lowestoft, Eng.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Operational experience of the nuclear power program in the United Kingdom has shown that the principal environmental consequences arise from the disposal of liquid radioactive waste, and relate to public health rather than to direct effects on resources. The emphasis on environmental protection programs has thus been on the limitation of public radiation exposure. Provided that this is held within the acceptable limits as defined by ICRP, resource considerations will be adequately protected. (auth)

26768 (CONF-730907-P1, pp 313-318) MODEL FOR THE EVALUATION OF THE DEEP OCEAN DISPOSAL OF RADIOACTIVE WASTE. Webb, G. A. M.; Morley, F. (National Radiological Protection Board, Harwell, Eng.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A mathematical model is developed to predict the eventual surface water concentrations of radioactivity as a result of continual deep ocean disposal of radioactive wastes over hundreds or thousands of years. The behavior of each nuclide is a function of the interaction between its half-life and the diffusion parameters. Uncertainties in the vertical diffusion coefficient are shown to have little effect on the final concentration values for nuclides with long half-lives. The processes of release, diffusion, circulation, uptake by fish and eventual transfer to man are used to calculate doses to man. These are then compared with ICRP limits to suggest limiting rates for continuous disposal of various classes of radionuclides. (auth)

26769 (CONF-730907-P1, pp 319-325) IMPACT OF TEN YEARS LIQUID WASTE MANAGEMENT PRACTICES ON ENVIRONMENTAL SAFETY AT BRADWELL POWER STATION, U.K. Wasson, M. M. (Central Electricity Generating Board, Essex, Eng.); Mitchell, N. T. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In the light of present concern over the environmental consequences of radioactive waste disposal from nuclear power plants, the experience gained in the control of discharge of low-level liquid effluents during the first ten years of operation of one of the first CEGB nuclear power stations, at Bradwell in south-east England is reviewed. Public radiation exposure from liquid waste disposal was kept to a very low level, never being more than a small fraction of one percent of the I.C.R.P. recommended dose limit. That this has been attained is largely due to the actions taken by the Power Station to counteract the changes in effluent composition so as to minimize the significance of discharges and their consequences. (auth)

26770 (CONF-730907-P1, pp 326-331) ENVIRONMENTAL RADIATION FROM ADVANCED GAS-COOLED REACTORS IN NORMAL OPERATION. Passant, F. H. (Central Electricity Generating Board, Cheltenham, Eng.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The normal operation of an AGR power station may lead to the release to atmosphere of several radioactive nuclides, each of which may contribute some small radiological dose to members of the public in the immediate vicinity of the power station. The significance of the release is examined in the context of present and possible future radiological criteria. The nuclides of significance are predicted to be ^{3}H, ^{16}N, ^{35}S, ^{41}Ar, ^{88}Kr, and ^{131}I and estimates of the likely releases of each are given for a typical 1250 MW(e) AGR power station (HinkleyPoint "B"). The sources of each nuclide are explained and a brief description of the relevant design features of the AGR is given. It is shown that the releases are almost entirely due to leakage of CO_2 from the primary coolant. Maximum permissible release rates for each of the nuclides are derived for the power station, which is sited in a farming area, based on the ICRP recommended annual doses to members of the public taking into account the critical route for each nuclide (e.g., inhalation, milk, etc.) and the critical group (e.g., 6 months old child). The predicted releases are compared with the ICRP-derived permissible releases, and with permissible releases based on the current CEGB radiological design criteria and possible future criteria in the U.K. or elsewhere (e.g., the proposed U.S. criteria). (auth)

26771 (CONF-730907-P1, pp 332-337) RESEARCH TO KEEP NUCLEAR POWER SAFE: THE EXPERIENCE OF A MAJOR INDUSTRY. Wheatley, B. M. (Central Electricity Generating Board, Berkeley, Eng.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The nationalized electricity industry of England and Wales is a single utility with a present installed capacity of 54 GW of which 3 GW is from nuclear power stations. The Central Electricity Generating Board (CEGB) is responsible to the national Parliament for operating its system safely and economically. It necessarily maintains a large research department to assist in obtaining or interpreting the data needed for planning, specifying, and operating its plant. Much of the research work is directed to environmental studies, particularly in atmospheric dispersion and hydroecology. In the nuclear field much of the work is concerned with the safety of structures and materials, and so affects radiological safety indirectly. Some of the work directly concerned with radiological safety is described. It is concluded that CEGB experience has shown it to be essential for a major utility company to maintain a vigorous health physics research program. (auth)

26772 (CONF-730907-P1, pp 344-349) LONG RANGE TRANSPORT AND DIFFUSION: AN APPROACH TO THE PROBLEM FROM THE HEALTH PROTECTION POINT OF VIEW. Cagnetti, P. (CNEN, Rome); Pagliari, M. Feb 1974.

From 3rd international congres of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The problem of transport and diffusion of gaseous radioactive effluents following releases in the atmosphere after travel distances from some tens up to some hundreds of kilometers is analyzed, with the aim of deriving an expression for the cloud-dosage at ground level. Taking into account the experimental data available at present, a function is calculated which relates the coefficient of diffusion to the time of travel. With very conservative assumptions from the health protection point of view, the radially symmetrical equation of diffusion has been solved for an instantaneous release, and the integrated concentration along the travel direction calculated. The results show that, only after a travel of 100 km the values of cloud-dosage are about ten times lower than that obtained by extrapolation of Pasquill estimates, during category F of stability. (auth)

26773 (CONF-730907-P1, pp 350-355) ESTIMATION OF GASEOUS RADIOACTIVITY RELEASE RATES FROM AN OPERATING BOILING WATER REACTOR. Keene, W. E.; Carey, W. M.; Battist, L. (American Environmental Control Systems, Inc., Gaithersburg, MD). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Noble gas activity (krypton and xenon isotopes) in BWR stack effluent is commonly estimated by applying a graphic curve-fitting technique to activity measurements on grab samples taken periodically at the steam jet air ejector. It is shown that the graphic solution may conceal significant anomalies in these data, which may be more readily discerned by changing the form of the plot. A better fit to the data is obtained by the method of least squares. (auth)

26774 (DUN-3155) INVESTIGATION OF EFFLUENT CONTROL STANDARDS AND PRACTICES. Loe, J. W. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 26 Sep 1967. 69p. Dep. NTIS $6.50.

This investigation showed that the chemical and sanitary effluents being released by the 300 area contractors to the process ponds and septic tanks do not contribute a significant amount of pollution to the environs. This conclusion is based on the results of a comprehensive sampling survey of the north process pond, Columbia River bank seepage, leaching trenches, and the Columbia River. Current storage facilities for liquid chemicals as presently located would not contribute a significant amount of water pollution in the Columbia River should a rupture or accidental drainage occur. Operating procedures are available involving the receiving, storing, and distributing of liquid chemicals and their subsequent use in the production process. These procedures provide a comprehensive summary of the methods utilized in controlling the various production process variables. Future action planned in order to assure continuing compliance includes the gathering of effluent samples by an automatic effluent sampler at the process pond inlet. Chemical and radiochemical analyses will be periodically performed. Grab samples will be taken from the wells in the vicinity of the ponds, along with Columbia River bank seepage samples, to assess the amount of contaminants in the ground water. Samples from the leaching trenches and Columbia River will continue to be taken and analyzed for Biochemical Oxygen Demand (BOD) and coliform content by Battelle–Northwest. (auth)

26775 (UNI-158) UNITED NUCLEAR INDUSTRIES INC., REACTOR AND FUEL PRODUCTION FACILITIES 1973 ENVIRONMENTAL RELEASE REPORT. Dabrowski, T. E. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 15 Mar 1974. Contract AT(45-1)-1857. 14p. Dep. NTIS $4.00.

During calendar year 1973, an estimated total of 3,000,000 lb of waste materials, including approximately 1 g of radionuclides, were discharged to the environs in liquid effluent streams emanating from United Nuclear Industries, Inc., operated facilities. During the same period, approximately 2,000,000 lb of reported waste materials, including a small fraction of a gram of reported radionuclides, were discharged to the atmosphere from United Nuclear Industries, Inc., operated facilities. (auth)

26776 ANALYSIS OF RADIATION EXPOSURES ON OR NEAR URANIUM MILL TAILINGS PILES. Schiager, K. J. (Colorado State Univ., Fort Collins). Radiat. Data Rep.; 15: No. 7, 411-425(Jul 1974).

Potential radiation exposures from abandoned uranium mill tailings piles may be predicted in a general manner using minimal input data. If the average radium concentration in the tailings C_{Ra} is known, the external gamma exposure rate over the tailings can be estimated from: $X(\mu R/h) \cong 2.5\ C_{Ra}$ (pCi/g). The radon emanation rate can also be estimated as: ϕ (pCi $Rn/m^2 - s) \cong 1.6\ C_{Ra}$ (pCi/g). The reductions of exposure rates that can be achieved by covering the tailings with earth or concrete also are discussed. Radon progeny inhalation exposures depend upon the dispersion rate of radon in the atmosphere and the time available for progeny ingrowth. Meteorological data for the site are required for making reliable predictions of inhalation exposures. It is shown, however, that contributions to the average annual outdoor radon progeny concentrations exceeding 0.003 WL are very unlikely on or near any tailings pile. The methods used to analyze potential radiation exposures are illustrated by a case study on one abandoned tailings pile. (auth)

26777 STUDY OF THE GASEOUS EFFLUENTS FROM AN OPERATING BOILING WATER REACTOR. Carey, W. M. Washington, DC; Catholic Univ. of America (1974). 149p. University Microfilms Order No. 74-14,943.

Thesis (Ph. D.).

A study has been performed to measure the gaseous radioactive effluent concentrations at distances up to 8210 meters (5 miles) from an operating nuclear boiling water reactor. Measurements of gaseous effluent concentrations as low as $10^{-9}\ \mu Ci/cm^3$ and as high as $10^{-6}\ \mu Ci/cm^3$ were obtained. Measurements were made with a monitoring system which measures gaseous radioactivity levels as low as $10^{-9}\ \mu Ci/cm^3$ at distances of 2570m, 5080m and 8210m from the reactor stack. Airborne gaseous radioactivity concentrations were measured continuously for three weeks at each location under various meteorological conditions. Peak concentrations above the threshold were observed with a frequency distribution which is Gaussian with respect to the wind direction at the reactor stack. To determine the plume constituents, spectroscopic and meteorological data was obtained at the point of discharge. From the measured gaseous radioactivity concentrations, meteorological data, and stack spectroscopic data, half-hourly, hourly, daily and monthly average values of the meteorological dispersion (χ/Q) were determined, ranging from $10^{-3}\ sec/m^3$ to $10^{-4}\ sec/m^3$. Peak-to-average values were also investigated. The effect of the plume's constituents, decay during transit to the monitor, and buildup of daughter radionuclides were considered. As the calculations usually employed to determine the dispersion of airborne radioactive effluents are strongly dependent on local topographical and meteorological conditions, the data gathered during this experiment demonstrate the micrometeorological influence on the calculated values of χ/Q and on the local site dosimetry. When these results were compared to the Pasquill-Gifford diffusion model gross qualitative agreement was obtained; however quantitative agreement for averaging times of a half-hour or less was not apparent. The results of this experiment clearly illustrate the importance of diurnal effects on downward concentrations and the fact that peak concentrations and external gamma fluxes are not adequately described by current models. These data indicate the desirability of inland meteorological measurements as well as future research in the dispersion of gases from reactors located on coastal sites. (Diss. Abstr. Int., B)

Radioactivity Monitoring and Transport

Refer also to abstracts 26482, 26774, 26838, 26841, 26842, 26857, 26898, 27094, and 27106.

26778 (AAEC/E-305(Report 4), pp 1-11) ENVIRONMENTAL LEVELS OF RADON-222. Davy, D. R. Jun 1974.

Factors which affect levels of radon in the atmosphere and ground water are discussed. Radon levels in costeans, coresheds and bore water are recorded and discussed. (AT)

26779 (AED-CONF-74-157-002) THE UNITED STATES ATOMIC ENERGY COMMISSION PROGRAM FOR THE CONTROL, MONITORING AND REPORTING OF RADIOACTIVITY IN EFFLUENTS. Biles, M. B.; Coffman, F. E. (USAEC Division of Operational Safety, Washington, D. C.). 1974. 6p. INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

2 figs.; 10 tabs.; 2 refs. With abstract.

Effluent monitoring and reporting programs are maintained at all U. S. Atomic Energy Commission (AEC) facilities discharging concentrations of radioactivity that have potential health and safety or environmental significance. The objective of these

programs is to assure effective management and control of effluents. To maintain an overview of its effluent control practices, the AEC had developed and instituted a computer-based annual effluent data reporting system to assure that effluent control programs are properly maintained. This system has proven to be a very useful internal management tool for evaluating the effectiveness of effluent control programs and for identifying potential problem areas. (auth)

26780 (CONF-730907-P1, pp 338-343) RADIOLOGICAL PROBLEMS ON MAGNOX REACTORS WITH INTEGRAL BOILERS, WITH PARTICULAR REFERENCE TO PERSONNEL ENTRY INTO THE PRESSURE VESSEL. Tresise, H. C. (Central Electricity Generating Board, Bristol, Eng.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Radiological data is presented for the first 4 years of operation of Oldbury Nuclear Power Station. Radiation doses to personnel on site are very low; the average whole-body dose is about 0.2 rems annually and the highest cumulative dose in 4 years is 2.6 rems. The total annual dose-commitment for operating, refuelling, and maintaining the two-reactor power station is below 100 man-rems. During periodic entries into the pressure vessel, the main problem is heat. Protective clothing to enable men to work for extended periods at temperatures up to 60°C is described. The special medical requirements and the method of selecting personnel to work under these conditions are indicated. Following an inspection period, ^{35}S is released in gaseous form during the dry-out of a reactor core. A monitoring technique is described and surveys confirm that locally produced milk is not affected. (auth)

26781 (CONF-730907-P1, pp 364-369) REVIEW OF THE FIRST SEVEN YEARS OF OPERATIONAL HEALTH PHYSICS AT DUNGENESS NUCLEAR POWER STATION. Goldfinch, E. P. (Central Electricity Generating Board, Kent, Eng.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The Dungeness Nuclear Power Station comprises two identical reactors each of the magnox type of nominal thermal power 725 MW(th), nominal electric power 205 MW(e). The first reactor achieved commercial full power in October 1965 and the second in December 1965. The reactors have been in operation with a lifetime load factor of 77.1% up to March 31st, 1973, and total electrical production 24.5 × 109 KWH (exported). Refuelling on magnox reactors is continuous with the reactor at full power. The health physics aspects of operation over the past seven years are reviewed. (auth)

26782 (CONF-730907-P1, pp 400-405) INVESTIGATION OF THE TRITIUM LEVEL IN THE ENVIRONMENT OF THE KARLSRUHE NUCLEAR RESEARCH CENTER. Koenig, L. A.; Winter, M. (Karlsruhe Nuclear Research Center, Ger.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A comprehensive tritium monitoring program was carried out in the immediate and more distant neighborhood of the Karlsruhe Nuclear Research Center. The results obtained in the measurement of tritium concentration in precipitations are characterized by strong seasonal variation. By contrast, the measured values for drinking water only show statistical scattering. The values of tritium concentration in surface water are on the average slightly higher than the values for drinking water. The tritium radiation burden to the population was estimated to be 0.1 mrem/a on the basis of the measured values available. (auth)

26783 (CONF-730907-P2, pp 870-881) INVESTIGATION AND STANDARDIZATION OF THE RADIOACTIVITY OF CONSTRUCTION MATERIALS. Krisyuk, E. M.; Lisachenko, E. P.; Tarasov, S. I.; Shamov, V. P.; Shalak, N. I. (Inst. of Radiation Hygiene, Leningrad). Feb 1974. (In Russian).

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Ionizing radiation in dwellings is one of the main sources of radiation effects on populations. Limitation or decrease of this factor may be done by standardization of radioisotope concentration in building materials. Gamma-spectrometric analyses for Ra-226, Th-232, and K-40 in 300 samples of building materials from various regions of the USSR have been performed and predicted values of gamma radiation doses in buildings made of these materials calculated. To evaluate the parameters determining air concentration of Rn in dwellings Rn accumulation and mechanism of its release were studied. For limitation of external gamma radiation levels in dwellings the following values of specific radioisotope permissible concentration are suggested: 10, 7, 126 PCi/g for Ra-226, Th-232, and K-40, respectively. For limitation of Rn concentration in dwellings permissible level of effective Ra-226 concentration (the product of Ra-226 concentration by emanation factor) has been recommended 0.6 pCi/g. (auth)

26784 DATA. Section IV. Other Data. Radiat. Data Rep.; 15: No. 7, 450(Jul 1974).

Data from environmental monitoring during 1971 at the Brookhaven National Laboratory, Oak Ridge area, and Pinellas Peninsula Plant (Florida) are presented. For BNL the tabulated data include: exposure rates at site perimeter; gross α and β and tritium content in surface air; β and γ emitters in liquid effluents; gross β and tritium in surface waters; γ emitters in river water and sediments; γ emitters in aquatic animals and fish; gross α and β activity and tritium, ^{90}Sr, and ^{137}Cs content in ground water; ^{137}Cs, ^{131}I, ^{40}K, and ^{90}Sr in area milk; ^{95}Zr, ^{137}Cs, ^{144}Ce, U, Th, and K content in soils; and ^{7}Be, ^{65}Zn, ^{95}Zn, ^{137}Cs, ^{144}Ce, U, Th, and K in grasses. For ORNL the tabulated data include: gross α and β activity and ^{131}I content in surface air; radioisotopes in Clinch River water; U content in surface streams; ^{90}Sr and ^{131}I content in milk; ^{137}Cs, ^{90}Sr, and ^{106}Ru content in Clinch River fish; and U in soils, plants, and grasses. Monitoring of sewer effluent, surface air, surface water, and milk near the Pinellas Peninsula Plant showed tritium release was well below AEC standards for continuous nonoccupation exposure. A nuclear explosion at the nuclear test area at Lop Nor, China on June 17, 1974 and a June 1974 UK underground nuclear test at the NTS in the US are reported. (LCL)

26785 ENVIRONMENTAL RADIATION EFFECTS OF NUCLEAR FACILITIES IN NEW YORK STATE. Terpilak, M. S.; Jorgensen, B. L. (Environmental Protection Agency, New York). Radiat. Data Rep.; 15: No. 7, 375-400(Jul 1974).

The annual quantities and types of radioactive materials released from three operating nuclear electric generating facilities, a national laboratory, and a nuclear fuels reprocessing facility are presented and discussed. The period of interest spans the years 1969 through 1972 with some additional data for those facilities operating before 1969. Release quantities have been well controlled, considering the nature and vintage of the operations. Results of environmental surveillance relying most heavily on the activities of the New York State Department of Environmental Conservation are presented. Observations at Indian Point Station Unit No. 1 and at Nuclear Fuel Services have led to the discovery of several facility-related radioisotopes in environmental media. These two facilities are of comparatively early vintage, have produced slightly larger amounts of waste materials and have been the subject of more comprehensive studies than others in the State. Dose consequences to hypothetical individuals and to populations within 50 miles of the facilities are addressed. It should be stressed that all individual doses presented are hypothetical. Doses via the drinking water and cow's milk pathways are particularly conservative. In each case, these hypothetical doses are at least an order of magnitude or more greater than the known worst case. No excessive exposure levels are known to have existed. All operations have resulted in postulated exposure levels well within applicable regulations or guidelines, generally being a small percentage of these values. Population doses have been surprisingly consistent through the period of interest. They are insignificant in comparison to the dose to the population of the State from natural or medical sources. (auth)

26786 DETERMINATION OF RADON DAUGHTERS' DISEQUILIBRIUM IN AIR BY GAMMA SPECTROMETRY. Rangarajan, C.; Chandrasekaran, V. R.; Gopalakrishnan, S. S.; Eapen, C. D. (Bhabha Atomic Research Centre, Bombay (India). Air Monitoring Section). Nucl. Instrum. Methods; 117: No. 2, 573-578(15 May 1974).

A new method based on gamma spectral analysis for measuring the individual concentrations of radon daughters in air is described. The method is particularly suitable for low activity levels as large volumes of air can be collected and measured without significant spectral distortion of the type observed in alpha-spectroscopic methods. By an extension of the method, thoron daughters can also be included in the analysis. A few

results of the measurements carried out using the method, on the extent of radon daughters' disequilibrium in the open air and in a uranium store room, are presented. (auth)

Atmosphere

Refer also to abstracts 26449, 27104, 27209, 27215, and 28743.

26787 (CONF-730907-P1, pp 406-410) ANALYSIS OF AN ANALYTICAL TECHNIQUE FOR DISTRIBUTING AIR SAMPLING LOCATIONS AROUND NUCLEAR FACILITIES. Waite, D. A. (Battelle Pacific Northwest Labs., Richland, WA). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A new analytical mechanism for distributing air sampling locations around nuclear facilities, including reactors, fuel fabrication, fuel reprocessing, and research centers, has been devised. This method was developed to facilitate the efficient incorporation of past experiences into environmental surveillance programs for new installations. The technique provides an initial distribution of air samplers around a site which correlates well with placements on sites which have been occupied by long-established programs with their inherent evolution and refinements. Sensitivities of calculated sampler distributions to various meteorologic and demographic input parameters are discussed. The applicability of this approach has been examined by comparing sampling locations in well-established air monitoring programs scattered worldwide with location distributions recommended by this mechanism. Results of these comparisons are detailed. (auth)

26788 EFFECT OF DIFFERENT UV RADIATION DOSES ON PIGMENTARY AND NONPIGMENTARY YEASTS. Angelova-Patarinska, Z.; Solakova, I. M. (Inst. of Industrial Microbiology, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 4, 543-546(1974).

The reaction of the yeast cell to uv radiation depending on the presence or absence of carotinoid pigments was investigated in Candida utilis and a pigment mutant strain γ-3. The following indicators were used as most general criteria of the yeast cell's biological reaction to uv radiation: cell survival after radiation; growth rate in liquid nutritive medium; determination of the quantity of the absolutely dry biomass at the end of cultivation; and determination of the quantity and quality of the carotinoid pigments in the cultures of the pigment strain. Results showed that action of the yeast cell to uv radiation is substantially affected by the presence or absence of carotinoid pigments. Low radiation doses produced a stimulating action on the growth of both strains. The carotinoid pigments produced a protective action with respect to high doses of uv rays. Only the pigmentary strain survived and shows growth. (CH)

26789 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 15: No. 7, 441-447(Jul 1974).

February 1974 measurements of the gross β-activity in surface air and atmospheric precipitation at 68 sampling stations in the US and at 24 stations in Canada, and in surface air only at 12 Pan American stations and at 18 stations in California are reported. (LCL)

26790 METHOD FOR MEASURING THE WORKING-LEVEL VALUES OF MIXED RADON AND THORON DAUGHTERS IN COAL-MINE AIR. Ogden, T. L. (Inst. of Occupational Medicine, Edinburgh). Ann. Occup. Hyg.; 17: No. 1, 23-34(Aug 1974).

The method was based on measuring the alpha-activity of shift-long respirable dust samples. Activity concentrations of a few thousandths of a working level were easily measured, and the value obtained was fairly close to a shift average. The sampling equipment used in trials was the MRE gravimetric dust sampler, which is safe for use in methane-air mixtures, and in British coal mines the measurements could be made on routine respirable dust samples. (auth)

26791 CORRELATIONS BETWEEN RADON AND CLOUD CONDENSATION NUCLEUS CONCENTRATIONS. Larson, R.E. (U.S. Naval Research Laboratory, Washington, D. C. 20375). J. Geophys. Res. 79: No. 24, 3476-3477 (20 Aug 1974).

A strong correlation has been observed between concentrations of radon (^{222}Rn) and cloud condenstation nuclei (CCN) during long-distance transit flights over North America and during several days of observations over Arizona. The correlation coefficient between the compared observations was 0.92 for transit flights at altitude 2000-4000 m. Correlation coefficients for five altitude profiles, each from 300 to 4500 m over Arizona were in the range of 0.73-0.95. Over oceans and snow-covered areas there was no correlation. There was no significant correlation for two vertical profiles over Arizona because of unusually high CCN concentrations between 2000 and 3000 m. (auth)

26792 ATMOSPHERIC ELECTRIC AND RADON PROFILES OVER A CLOSED BASIN AND THE OPEN OCEAN. Anderson, R.V.; Larson, R.E. (Naval Research Laboratory, Washington, D. C. 20390). J. Geophys. Res. 79: No. 24, 3432-3435 (20 Aug 1974).

Measurements of atmospheric electricity and radon (^{222}Rn) gas were made in February 1972 over the Yukon basin in Alaska and over the ocean near Hawaii. A strong, deep temperature inversion was observed over the Yukon, but there was only a weak trade wind inversion over the ocean. Over Alaska, radon was trapped near the surface in the inversion, and the electrical conductivity was measurably increased above normal at altitudes of 90 and 150 m above the terrain; the qualitative agreement between the radon concentration and the conductivity increase at low levels is good. The current density computed as the product of conductivity and electric field was observed to be substantially constant with height over the Yukon but not over the ocean. It is concluded that representative electrical measurements should not be attempted without investigating possible interfering conditions and that it is possible for natural atmospheric radon to have a direct measurable effect on atmospheric conductivity. (auth)

Soil

26793 (CONF-730907-P2, pp 900-911) APPROACH TO RADON PROBLEMS IN NON-URANIUM MINES IN SWEDEN. Snihs, J. O. (National Inst. of Radiation Protection, Stockholm). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In Sweden there are about 60 underground mines. These are for the mining of ferrous and sulphide ores and none are for uranium. Radon measurements were made in all of these mines during 1969 and 1970. By using an assumed equilibrium ratio of 0.5 between radon daughters and radon, the radon daughter levels were calculated to exceed 30 pCi/l (0.3 WL) in 22 mines with more than 1000 underground employees and in a few mines the levels were estimated to exceed 100 pCi/l (1 WL). Hence, non-uranium miners were the largest group of Swedish workers receiving significant radiation doses. However, these workers are not legally classified as radiological workers. The sources of radon in mines are found to be radon-rich water, ventilation air from abandoned areas with caved materials and, to a lesser extent, minerals particularly rich in radium. In some mines the radon levels vary with the season with a maximum in the summer. No simple correlation to the type of minerals or their geological properties has yet been found. Instructions on protective measures against radon in mines were issued in March 1972. The regulations are based on a maximum of 30 pCi/l (0.3 WL) of radon daughters as the average over a year. There are also regulations on the maximum delay period for preventative action, on ventilation, on respirators, on measurements and control, and on medical examinations. Epidemiological studies on the lung cancer frequency among miners have been made. The period investigated was the years 1961-1968. A significant excess of lung cancer has been found. (auth)

26794 (COO-3573-8, pp vp 2p) DISTRIBUTION OF URANIUM AND ITS DECAY SERIES NUCLIDES AND TRACE METALS IN A HUBBARD BROOK, NEW HAMPSHIRE SOIL PROFILE. Kharkar, D. P.; Thomson, J.; Turekian, K. K.; McCaffrey, R. J. 1 Apr 1974.

In trace elements in natural waters.

A soil profile from the Hubbard Brook metered experimental forest was analyzed for ^{238}U, ^{234}U, ^{232}Th, ^{230}Th, ^{226}Ra, ^{210}Pb and Cu, Zn, Cd, Pb. The ^{232}Th concentration remains constant on an organic free basis thus indicating that the other elements are mainly associated with either the organic fraction or a clay or oxide component closely linked to the organic component in distribution. The uranium isotope ratio is unaffected by the weathering process. ^{230}Th and ^{226}Ra both have been mobilized but ^{230}Th least of all. The sequence of mobilization during weathering is then: ^{238}U (^{234}U) > ^{226}Ra > ^{230}Th. (auth)

26795 (COO-3573-8, pp vp 17p) URANIUM AND THORIUM DECAY SERIES NUCLIDES IN SUSPENDED SEDIMENT OF THE CONNECTICUT RIVER. Cochran, J. K.; Benninger, L. K.; Lewis, D. M. 1 Apr 1974.

In trace elements in natural waters.

The isotopes of the naturally occurring uranium and thorium decay series have been extensively applied to the study of deep-sea sedimentation processes. More recently, their usefulness

in the study of near-shore processes has been demonstrated as well. Critical to the understanding of the behavior of these isotopes in near-shore sediments like those of Long Island Sound is a knowledge of their fractionation among the particulate material carried by rivers and the uptake or loss of the various nuclides during sediment transport prior to deposition. Preliminary determinations of ^{234}U, ^{238}U, ^{230}Th, ^{226}Ra, ^{232}Th and ^{228}Th in the suspended particulates of the Connecticut River are presented. The samples were collected during a period of flood discharge of the river (7/4/73), and consequently the suspended load was large. In addition to analyses for U-Th series isotopes, a number of other parameters (salinity, alkalinity, dissolved silica, and suspended load) were measured in order to better characterize the river conditions at the time of sampling. (auth)

26796 EMANATION AND EXHALATION OF RADON AND THORON GASES FROM SOIL PARTICLES. Megumi, K.; Mamuro, T. (Radiation Center of Osaka Prefecture, Sakai, Osaka, Japan). J. Geophys. Res. 79: No. 23, 3357-3360 (10 Aug 1974).

Samples of soil originating from the weathering of granite rock were sieved into eight classes of particle size. Each sieved sample was measured for its content of ^{226}Ra (parent nuclide of radon), ^{224}Ra (parent nuclide of thoron), ^{228}Ac (grandparent nuclide of ^{224}Ra), K, Ca, and Fe as well as for the radon and thoron emanation from it. There was a trend for the contents of ^{226}Ra and ^{224}Ra to increase as particle size decreased. On the other hand, the K content showed a different variation with particle size from the variations found for ^{226}Ra and ^{224}Ra. On the basis of the results of the emanation measurements, it was concluded that smaller soil particles make relatively more contribution to radon and thoron exhalations from the ground surface than larger soil particles, but they make absolutely less because of their smaller abundance. (auth)

Water

26797 (CONF-730907-P1, pp 272-278) HIGH RADIOACTIVITY IN DRINKING WATER AND GROUND WATER IN SOUTH TEXAS. Wukasch, M. C.; Cook, L. M. (Texas State Dept. of Health, Austin). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Radioactivity measurements in South Texas have demonstrated that high gross α, gross β, and radium-226 levels exist in natural ground waters. Levels of radium-226 over 50 times recommended drinking water limits have been found. Data on some water wells sampled are presented, and correlation of radioactivity versus water quality and well depth is attempted. Body burden estimates are presented for some individuals. (auth)

26798 (COO-3573-8) TRACE ELEMENTS IN NATURAL WATERS. Annual Progress Report, July 1, 1973–June 30, 1974. Turekian, K. K. (Yale Univ., New Haven, Conn. (USA). Dept. of Geology and Geophysics). 1 Apr 1974. Contract AT(11-1)-3573. 169p. Dep. NTIS $11.50.

Nine papers were presented. A separate abstract was prepared for each of 8 papers. One paper was not within the scope of NSA. (LCL)

For abstracts of individual papers see: 26794, 26795, 26811–26814, 26827, and 26828.

26799 DATA. Section II. Water. Radiat. Data Rep.; 15: No. 7, 437-440(Jul 1974).

January through December 1971 data on the gross β activity in raw and treated surface water and the gross α and β activity in sewage plant effluents in North Carolina are reported. (LCL)

26800 RATIO OF ^{137}Cs–^{90}Sr IN OCEAN AND SEA WATER. Trusov, A. G.; Ivanova, L. M.; Gedeonov, L. I. Sov. At. Energy (Engl. Transl.); 34: No. 5, 481-482(May 1973).

Translated from At. Energ. (USSR); 34: No. 5, 394(May 1973). This is a summary of paper No. 668/7235 with full copy held at TIC.

The chemical state and abundances of ^{90}Sr and ^{137}Cs in seawater are considered. It was concluded that radioisotopes that have penetrated the water are rapidly subjected to exchange with their own stable isotopes and then share the fate of the ocean strontium and cesium. (MCG)

Ecosystems and Food Cycles

Refer also to abstracts 26831, 27257, 27259, and 27263.

26801 (CONF-730907-P1, pp 254-259) RADIATION-HYGIENIC EVALUATION OF GEOCHEMICAL PROVINCES WITH INCREASED CESIUM-137 MIGRATION. Marei, A. N.; Barkudarov, R. M.; Novikova, N. Ya. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Results are reported from studies on ^{137}Cs transfer through the food chain. The areas with increased uptake of ^{137}Cs from the soil into the plants and food (milk, meat) have been identified. The ^{137}Cs content in these foods exceeds by 10 to 100 times the average value for the Soviet Union. Accordingly ^{137}Cs contained in the bodies of the rural population is also higher. The average internal radiation doses for humans of various ages ranged from 11 to 19 mrem/year. The possibilities of leukemia occurrence is considered. It is shown that probability for leukemia development during 70 years is 1.2 ± 10^{-3}%. (auth)

26802 (CONF-730907-P1, pp 266-271) ANALYSIS OF GEOGRAPHICAL DIFFERENCES IN THE RATE OF PURIFICATION OF THE CHAIN LICHENS–REINDEER–MAN FROM CESIUM-137. Troitskaya, M. N.; Ibatullin, M. S.; Litver, B. Ya.; Moiseev, A. A.; Nizhnikov, A. I.; Ramzaev, P. V.; Teplykh, L. A. (Inst. of Radiation Hygiene, Leningrad). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The experiments carried out by a number of research workers in the past 10 to 15 years have proved the food chain lichen–reindeer–man in the Arctic areas to have the highest ^{137}Cs concentration from global fallout. The ^{137}Cs clearance dynamics of this chain in the years 1961 to 1973 along the Soviet coastline of the Arctic Ocean stretching for many thousands kilometers from Alaska to Finland was investigated. The relevant data were obtained from 5 regions for all the links of the chain and compared with other similar chains. The northern chain was found to clear about 2 times slower than other chains. The clearance rate varied in the range of 2 or more times in different geographical regions. (auth)

26803 (CONF-730907-P1, pp 279-284) ^{137}Cs and ^{134}Cs DISTRIBUTION IN SEDIMENT, WATER, AND BIOTA OF THE LOWER HUDSON RIVER AND THEIR DOSIMETRIC IMPLICATIONS FOR MAN. Wrenn, M. E.; Jinks, S. M.; Cohen, N.; Hairr, L. M. (New York Univ. Medical Center, NY). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Since 1964, the magnitudes and distributions of natural, fallout, and reactor-produced radionuclides present in the lower Hudson River Estuary have been under study. Concentrations of the major radionuclides released to the estuary in liquid waste from a pressurized light water reactor have been measured in samples of water, sediment, and biota. These measurements have been combined with information related to site characteristics and human use of the environment to obtain estimates of the magnitudes and pathways of human radiation exposure from routine power reactor operation. At present ^{137}Cs and ^{134}Cs are the critical radionuclides in the lower estuary, and consumption of fish is the most important route of exposure for man. Based on measurements to date, releases from a PWR of 20 Ci/yr each of ^{137}Cs and ^{134}Cs would result in an annual total-body dose to an avid local fish eater of about 0.2 mrem/year. (auth)

26804 (CONF-730907-P2, pp 1066-1071) GENETIC DOSE LIMIT FOR GENERAL POPULATION, DOSE LIMIT, AND DERIVED CONCENTRATION GUIDES FOR MEMBERS OF THE PUBLIC: COMPULSIVE ACTION GUIDES FOR EMERGENCY SITUATIONS. de Nulman, R. M. (Instituto Nacional de Energia Nuclear, Mexico City); de la Rosa, C. A. Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Using methods recommended by ICRP & UNSCEAR, the mean age of childbearing and genetic dose limit was calculated for the Mexican population. Data for the Mexican population when available, complemented with internationally recommended data, are

used to derive concentration guides for several radionuclides in various environmental media. Derived concentration guides in sea water are calculated applying the specific activity concept. Emergency projected doses demanding action to be taken are proposed. Data lacking is emphasized in order to encourage further studies on habits, critical pathways and transfer factors through food chain for radionuclides in Mexico. (auth)

26805 (F-597) DAILY IODINE CONTENT OF URINE FROM FOUR PLACES IN NORWAY, WINTER 1972/1973. Mathisen, O. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Feb 1974. 22p. (In Norwegian). Dep. NTIS (US Sales Only) $4.25.

Earlier investigations have been continued on the level of iodine intake in Norway. The concentration of iodine in 24-hour samples of urine from men at four places has been measured during the winter 1972/73. Consistent with earlier findings, the variation from place to place is barely noticeable, a mutually significant difference in levels can only be pointed out for a single pair (P = 3.6%). At two of the places the winter 72/73 levels are significantly higher than those of the winter 71/72. The material gives no justification for the addition of iodine in the diet. A further broader investigation of iodine in 24-hour urine samples, TSH, and inorganic iodide in plasma would be of great interest. (auth)

26806 (SRO-641-14) RADIOACTIVE TRACER STUDIES OF SOIL AND LITTER ARTHROPOD FOOD CHAINS. Summary Report, 1971–1974. Crossley, D. A. Jr. (Georgia Univ., Athens (USA)). 15 Aug 1974. Contract AT(38-1)-641. 64p. Dep. NTIS $6.25.

Data are presented on the content of fallout ^{137}Cs in soil and leaf litter arthropod food chains of granitic outcrop ecosystems in Georgia during 1971 to 1974. Samples of soil, lichens, mosses, vascular plants, and arthropods were analyzed for ^{137}Cs and also for K, Ca, and Na. Results are included from laboratory studies of mineral cycling in litter arthropod food chains in which ^{134}Cs and ^{85}Sr were used as tracers for K and Ca. (CH)

26807 AEROSOL PARTICLES ON TOBACCO TRICHOMES. Fleischer, R. L.; Parungo, F. P. (National Oceanic and Atmospheric Administration, Boulder, CO). Nature (London); 250: No. 5462, 158-159(12 Jul 1974).

Reference is made to Martell (Nature 249: 215 (1974)) who proposed a way in which atmospheric radioactivity may be incorporated into the lungs of tobacco smokers. The α-radioactivity, due to Rn and its decay products, becomes attached to sub-micron atmospheric particles which become attached to the sticky tips of tobacco trichomes. In support of Martell's suggestion that the radioactivity observed on trichomes comes from atmospheric aerosols, evidence was obtained that aerosols are in fact present on and inside trichome tips. Trichomes from N. Carolina flue-cured and Turkish air-cured tobacco leaves were examined in a Cwikscan 100 instrument equipped with a Kevex x-ray energy spectrometer, which allowed visual observation at high magnification and detection of elements in particles down to 250 A diameter. Aerosols > 0.5μm diameter could be examined individually on the surface of the trichomes, and could be seen attached to the trichome tips. Where individual particles were not seen the relevant signal came from many very small aerosols trapped within the exudate on the trichome tips. This agrees with Martell's reasoning that Rn daughter radioactivity precipitates on aerosols that diffuse to trichome tips and later become insoluble residues in tobacco smoke. (UK)

26808 ACCUMULATION OF ^{137}Cs BY FUNDULUS HETEROCLITUS IN THE HUDSON RIVER ESTUARY. Mauro, J. J. New York; New York Univ. (1973). 131p. University Microfilms Order No. 74-16,845.

Thesis (Ph. D.).

The pathways by which Fundulus heteroclitus (the saltwater killifish) obtain radiocesium from the Hudson River estuary in the vicinity of Indian Point and the effect of salinity on this uptake were quantitatively determined by the use of laboratory and field studies. Based on the results of these studies, a theoretical model was developed to predict the expected concentration of radiocesium in fish. The ingestion rate was determined by sequential sampling and stomach content analyses of F. heteroclitus obtained from the Hudson River. These studies revealed that F. heteroclitus fed predominately on filamentous algae, Gammarus and rooted aquatic vegetation, and the Fundulus ingested 14% of their body weight per day during the growing season (April to November). Laboratory and field studies revealed that the activity of radiocesium in the food organisms depended strongly on the salinity of the water. The fractional assimilation of ^{137}Cs from ingested food, determined in the laboratory, was close to 100%. However, the presence of sediment along with the ingested material markedly reduced the assimilation of radiocesium from food. It is believed that during the digestion process the ^{137}Cs in the food became strongly sorbed onto the sediment which was associated with the ingested food, thereby reducing the assimilation of the ^{137}Cs by the fish. Gammarus, filamentous algae and higher plants were the major sources of radiocesium in the diet of F. heteroclitus in the Hudson River. Direct sorption of radiocesium from water by F. heteroclitus in the Hudson River contributed a very small portion of the total radiocesium. F. heteroclitus in the Hudson River inadvertently ingest some sediment during the feeding process, making sediment a source of radiocesium for Fundulus. Laboratory experiments revealed that only a small portion (about 3%) of the ^{137}Cs on the ingested sediment may be assimilated. However, due to the relatively high concentrations of radiocesium in the sediment, this route of uptake is not necessarily insignificant. The level of significance of uptake of radiocesium from the sediment varies inversely with the activity of the water. During times when the release rates of radiocesium by Con Edison resulted in an increase in the activity of the river water, the activity in the food organisms increased while the activity of the sediment remained essentially constant. Therefore, the relative importance of uptake of radiocesium due to the ingestion of sediment was small, about 3%. However, during times of low release rates, the activity of the water and food organisms declined while the activity of the sediment remained unchanged. Under these conditions, the relative importance of uptake of radiocesium from the ingested sediment became significant, about 25%. The sediment, therefore, plays a dual role in the cycling of ^{137}Cs in the Hudson River estuary. During times of high release rates, the presence of sediment in the ingested foods reduces the uptake rate of ^{137}Cs in Fundulus by reducing the assimilation of ^{137}Cs. During times of low release rates, the ingestion of sediment can be responsible for much of the uptake of ^{137}Cs by Fundulus because sediment retains its ^{137}Cs long after the activity in the water and food organisms declines. Whether food organisms of F. heteroclitus were obtaining radiocesium from the sediment was investigated since this is a possible mechanism by which radiocesium may be recycled from the sediment through the aquatic food chain. Filamentous algae necessarily obtain all their radiocesium via direct sorption from water. A literature review revealed that rooted aquatic plants may obtain significant amounts of radiocesium from the sediment. Laboratory experiments revealed that Gammarus obtained a large majority of its ^{137}Cs from direct sorption from water. Accordingly, the only potential route of recycling of radiocesium from the sediment to F. heteroclitus was either by direct ingestion of sediment or by the ingestion of rooted aquatic plants which may obtain a significant portion of their radiocesium from the sediment. In addition to the uptake rate, the elimination rate was investigated in the laboratory in order to quantitatively determine the temporal behavior of radiocesium in F. heteroclitus. The elimination rate consisted of two components, a long term component comprising about 80% of the body burden with a biological half life (Tb ½) of about 260 days and a short term component comprising about 20% of the body burden with a Tb ½ of about 6 days. There was no detectable difference in the elimination rate of ^{137}Cs among fish with weights between 2 and 14 grams but there was an indication that the salinity, temperature of the media and starvation of the fish influenced the elimination rate. (Diss. Abstr. Int., B)

26809 DATA. Section I. Milk and Food. Radiat. Data Rep.; 15: No. 7, 427-436(Jul 1974).

Data on the ^{137}Cs and ^{90}Sr content in milk at 63 sampling stations in the US, 16 in Canada, and 7 stations in Central and South America and Puerto Rico are reported for February 1974 and for the 12-month period from March 1973 to March 1974. (LCL)

26810 CONCENTRATION OF RADIOACTIVE COBALT BY MICROSCOPIC ALGAE IN RELATION TO ITS CHEMICAL FORM. Paoletti, A.; Bartoli, G.; Parrella, A.; Sandhelli, G. (Univ., Naples). Nuovi Ann. Ig. Microbiol.; 24: 252-273(1973). (In Italian).

Since ^{58}Co and ^{60}Co represent the radionuclides with the highest percentage in nuclear power plants effluents, at least 5 days after emission, these waters treatment by means of oxidation ponds appears to be realizable in order to reduce residual activity through biological means, exploiting the well known general property of seaweeds to fix radionuclides. The study's purpose is to ascertain if it is possible to improve these properties by varying the salt to which cobalt is linked. By using three out of the most common salts (cobalt sulphate, nitrate, and chloride) it was noticed that ^{58}Co chloride is fixed by seaweeds with a percentage of about 40%, nitrate with a percentage of 20%, and sulphate with a percentage of 10% only. These results were attained even if it was possible to notice a development intensity of seaweeds of opposite order for the three salts. The preliminary study, carried out with stable cobalt salts, allowed

to make clear their toxicity limits for seaweeds, permitting as well to choose suitable culture mediums. (auth)

Radiometric Techniques

Refer also to abstracts 26450 and 26761.

26811 (COO-3573-8, pp vp 31p) ACCUMULATION OF METALS IN AND RELEASE FROM SEDIMENTS OF LONG ISLAND SOUND. Thomson, J.; Turekian, K. K.; McCaffrey, R. J. 1 Apr 1974.

In trace elements in natural waters.

The detailed analysis of a short diver-obtained core and a long gravity core along a line south of New Haven harbor is used to determine the modes and rates of accumulation of metals over time in sediments of central Long Island Sound and the patterns of their release. The ^{210}Pb dating of the long core shows an increase in Zn, Cu, Pb, Hg and Mn (the metals determined) over the last 70 years. This is presumed to be the consequence of human activity around the Sound. The short diver-obtained core was analyzed for ^{210}Pb, ^{226}Ra, ^{234}U, ^{238}U, ^{230}Th and ^{232}Th as well as Cu, Pb, Zn, Cd and Mn. The interpretation of the sedimentary and chemical data yields a picture of an episodic deposition of approximately 18 cm of sediment about 16 years ago with subsequent bioturbation of the upper 10 cm with the lower portion retaining its stratification. Loss of U and ^{228}Ra (and probably ^{226}Ra by analogy) and gain of ^{210}Pb, ^{228}Th and possibly some Mn has occurred since the sediment load was deposited. The metals Cu, Pb and Zn showed no loss from the sediment. (auth)

26812 (COO-3573-8, pp vp 7p) INFLUENCE OF DEPOSIT-FEEDING BENTHOS ON MATERIAL EXCHANGE AT THE SEDIMENT–WATER INTERFACE. Aller, R. C. 1 Apr 1974.

In trace elements in natural waters.

Experiments set up to investigate the effects of bioturbation on the chemistry of surface sediments and to evaluate its geochemical significance are described. The bioturbation considered is the mixing, irrigation and altering of the structure of the sediments as the result of feeding, respiration, and dwelling-construction activities by infaunal marine organisms. The first experiments will study the behavior of Mn and Fe in sediment systems using ^{60}Co or ^{210}Pb tracers. No results are reported. (LCL)

26813 (COO-3573-8, pp vp 28p) NATURAL RADIOCHEMICAL AND GROWTH RECORDS IN CONTEMPORARY HERMATYPIC CORALS FROM THE ATLANTIC AND CARIBBEAN. Dodge, R. E.; Thomson, J. 1 Apr 1974.

In trace elements in natural waters.

The skeletal banding observed in vertical cross sections of two species of coral, Montastrea annularis from Jamaica and Diploria labrynthiformis from Bermuda, was confirmed to be annual by ingrowth of ^{228}Th towards radioactive equilibrium with ^{228}Ra taken up from seawater. In addition the Bermuda coral has incorporated ^{210}Pb at essentially constant specific activity over the last 30 years. In a contemporaneous suite of specimens of D. labrynthiformis from Bermuda, individual annual patterns of growth banding are shown to be correlative. Of several parameters compared, maximum skeletal density per band per year gives the best correlation between corals. The mass accretion per year of the suite is less variable than either annual band width or skeletal density, but tends to follow the yearly fluctuations in density. Some factor operating during winter is postulated to determine the skeletal characteristics of any given year. (auth)

26814 (COO-3573-8, pp vp 30p) RECORD OF TRACE METAL FLUXES TO A CONNECTICUT SALT MARSH AS DETERMINED BY ^{210}Pb DATING. McCaffrey, R. J.; Thomson, J. 1 Apr 1974.

In trace elements in natural waters.

A drill core was obtained from a salt marsh near East Haven, Connecticut and analyzed to determine the amounts and distribution with depth of the trace metals Cu, Fe, Pb, and Zn. The ^{210}Pb dating method was used to determine the age of layers within the core, and the time of deposition of the trace metals. (LCL)

26815 OBSIDIAN HYDRATION PROFILE MEASUREMENTS USING A NUCLEAR REACTION TECHNIQUE. Lee, R. R.; Leich, D. A.; Tombrello, T. A.; Ericson, J. E.; Friedman, I. (California Inst. of Tech., Pasadena). Nature (London); 250: No. 5461, 44-47 (5 Jul 1974).

Ambient water diffuses into exposed surfaces of obsidian to form a hydration layer that increases in thickness to a depth of 20 to 40 μm, and that this layer forms the basis of obsidian dating. A description is given of the use of the resonance at a ^{19}F energy of 16.45 MeV in the reaction ^{1}H(^{19}F,$\alpha\gamma$)^{16}O to measure the hydration profiles; at resonance this reaction, and in particular the γ-production, proceeds at a rate proportional to the H concentration in thin layers and hence proportional to the water concentration. A monoenergetic beam of ^{19}F^{4+} ions with energy slightly above the resonance energy was employed, the ions being slowed down due to electronic collisions. Hydration profile measurements are described on a number of obsidian samples with hydration bands of less than 2 μm. The γ counting rate was converted to water concentration by comparison with a standard chlorite sample of known H content and with other mineral standards. The hydration profiles can be used to obtain information about the mechanism of water diffusion into obsidian and the factors influencing hydration. A significant improvement was achieved over results obtained with optical techniques. (UK)

26816 USING ARTIFICIAL THERMOLUMINESCENCE TO REASSEMBLE STATUES FROM FRAGMENTS. Afordakos, G.; Alexopoulos, K.; Miliotis, D. (Univ. of Athens). Nature (London); 250: No. 5461, 47-48(5 Jul 1974).

It was found that the glow curves of samples of marbles and limestones (natural thermoluminescence curves) as taken from different quarries did not allow determinations of origin to be made, since in nearly every case only a single peak was obtained. Glow curves of artificial thermoluminescence, however, provided considerably more information. These curves were obtained by heating samples until the NTL was erased, then exposing them to x rays at room temperature, and subsequently heating them at a constant rate. Another type of glow curve, termed a curve of mixed thermoluminescence, was obtained by exposing untreated samples to x-rays at room temperature and subsequently heating them at constant rate. With this kind of glow curve the ATL is superimposed on the NTL curve, and most MTL curves showed three peaks, and provided five parameters for sample identification. Because of differences in the parameters of samples from any one quarry it was not possible to identify unambiguously the origin of any piece of marble. The differences between samples from any one block were small, however, suggesting a good possibility of determining whether fragments are from the same statue or slab. The method was of great assistance in the restoration of statues from fragments found in a shipwreck. (UK)

26817 PETROGENETIC IMPLICATIONS OF ARGON ISOTOPIC EVOLUTION IN THE UPPER MANTLE. Brown, J. F.; Harper, C. T.; Odom, A. L. (Oxford Univ.). Nature (London); 250: No. 5462, 130-133(12 Jul 1974).

It is stated that the construction of models for the isotopic evolution of terrestrial Ar has been severely hampered by the lack of studies of the initial Ar isotopic ratios in rocks of various ages. Estimations of the cosmic abundances of the stable Ar isotopes give a ^{40}Ar/^{36}Ar ratio of 0.005, which may reasonably be assumed to approximate closely to the initial ratio in the solid Earth at the time of formation. Reported abundances in the terrestrial atmosphere, however, give a ratio of 295.5. This anomalous situation is related to the production of radiogenic ^{40}Ar from the decay of ^{40}K in the Earth's crust and mantle, and an increase of more than four orders of magnitude over the initial terrestrial ^{40}Ar/^{36}Ar ratio is indicated. In order to demonstrate the isotopic evolution of Ar in the solid earth a calculation was made of the ^{40}Ar/^{36}Ar ratios in mantle derived igneous rocks of different ages. A plot of the initial ratios against the time of emplacement or extrusion strongly suggests an increase in the ratio with time. A similarity between the ^{40}Ar/^{36}Ar ratio in the upper mantle and the terrestrial atmosphere leads to the conclusion that it is the Earth's mantle, and not the crust, that is the major source of atmospheric Ar. Modern plate tectonic theory provides a viable mechanism for the continuous release of Ar from the mantle, due to volcanism on active plate boundaries. According to the proposed model approximately 95% of all the ^{40}Ar produced has been lost to the atmosphere, and at least that percentage of ^{36}Ar must also have been lost, assuming no isotopic fractionation. It is considered that initial ^{40}Ar/^{36}Ar ratios for igneous rocks are potentially more sensitive petrogenetic indicators than Sr or Pt isotopes. (UK)

26818 HYDROLOGIC AND HYDRAULIC ASPECTS OF THE KARSTIC UNDERGROUND FLOW TRACING. Hribar, F.; Bidovec, F. (Ljubljana Univ. (Yugoslavia). Hidrometeoroloski Zavod). No. 2, 35-60(1972). (In German).

5 figs.

Because of the ever increasing needs, the water supply is an acute problem, especially in the waterless karst areas. Hydrologic studies of the karst need to be made. While tracing underground flows, it is not possible to determine the water quantities of inflow

and outflow using the dilution method. Neglecting the fact that circumstances of underground flows do not suit conditions in which dilution method should be used for measuring the water quantities leads to false conclusions. This was especially the case with some underground flows tracing done recently using radioactive isotopes. (auth)

Site Surveys

Refer also to abstracts 26406, 26515, 26528, 26814, 26831, and 28854.

26819 (AAEC/E-305) ALLIGATOR RIVERS AREA FACT FINDING STUDY. Four AAEC Reports. Newton, P. J. F. (ed.). (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1974. 182p. Dep. NTIS (US Sales Only) $12.25.

Four reports on environmental conditions of the Northern Territory Uranium Province in Australia are presented. A separate abstract was prepared for each report. (LCL)

For abstracts of individual papers see: 26757, 26778, 26820, and 26821.

26820 (AAEC/E-305(Report 1), pp 1-71) FRESHWATER FISHES OF THE ALLIGATOR RIVERS "URANIUM PROVINCE" AREA (TOP END, NORTHERN TERRITORY), WITH PARTICULAR REFERENCE TO THE MAGELA CREEK CATCHMENT (EAST ALLIGATOR RIVER SYSTEM). Pollard, D. A. (New South Wales State Fisheries, Sydney). Jun 1974.

The results of a survey carried out for the Australian Atomic Energy Commission during June and July 1972 of the fishes of the Magela Creek catchment and some other sections of the East Alligator River system are reported. The major part of the survey was conducted in conjunction with the collection of live fishes for use in bioassay experiments. These experiments were designed to determine the toxicities of a number of heavy metals, and also other toxicants expected to be present in uranium mining and processing waste-waters, to the aquatic fauna of the area. Such a comprehensive inventory of the ichthyofauna of the area was necessary to evaluate the effects of any possible future pollution of these river systems resulting from such changing land use. (auth)

26821 (AAEC/E-305(Report 3), pp 1-71) ENVIRONMENTAL STUDIES, NORTHERN TERRITORY URANIUM PROVINCE, 1971/73. Davy, D. R.; Conway, N. P. Jun 1974.

Results are presented of the chemical and radiological qualities of natural waters, the solubility of uranium in sediments, and the fate of dissolved trace elements in the drainage systems. (AT)

26822 (BMI-171-157) AMCHITKA BIOENVIRONMENTAL PROGRAM. Bioenvironmental Safety Studies, Amchitka Island, Alaska. Spring, 1974 Task Force Report. Kirkwood, J. B. (Comp.). (Battelle Columbus Labs., Ohio (USA)). Aug 1974. Contract AT(26-1)-171. 43p. Dep. NTIS $4.00.

Since 1968 bioenvironmental research designed to predict the effects of nuclear testing activities, recommend measures for minimizing adverse effects, and measure and evaluate the effects, both shortterm and longterm has been carried out at Amchitka Island, Alaska. The findings made by a scientific field party that visited Amchitka during the period May 21 through June 1, 1974 are presented. (CH)

26823 (BNWL-SA-5033) CROSS-ANALYSIS OF PARALLEL AND ORTHOGONAL WIND COMPONENTS ALONG A LINE OF TOWERS OVER HOMOGENEOUS DESERT TERRAIN. Powell, D. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 6p. (CONF-740922-6). Dep. NTIS $4.00.

From symposium on atmospheric diffusion and air pollution; Santa Barbara, California, USA (9 Sep 1974).

Tower arrays were placed at 4, 8, 16, 32, 64, and 128 m apart and 8, 20, 50, 125, and 312 m apart at the Hanford meteorological site located on a broad level expanse of desert with sagebrush and clump grass vegetation. Analyses of two tests with the azimuth angle between the tower line and the mean wind direction at less than 10 degrees are presented. Comparisons were made from data of the decay factors for alongwind separations for all three wind components — stability, roughness, and turbulence intensity. (MCW)

26824 (CONF-730907-P1, pp 308-312) CLIMATOLOGICAL AND METEOROLOGICAL CONSIDERATIONS FOR SITING OF NUCLEAR INSTALLATIONS IN HILLY OR MOUNTAINOUS ENVIRONMENT. Nagel, E. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In Switzerland the geographical regions where nuclear installations can be built are the Midlands, situated between the Alps and the Jura mountains, where most of the population and industries are concentrated, and the broad valleys in the alpine zone. In each region similar conditions of the general climate exist but local factors due to terrain feature and orientation make is not possible to deduce the characteristic data for a specific site from those for another location. Local, even short time investigations are necessary to obtain data on distribution and persistence of critical wind directions. (auth)

26825 (CONF-730907-P1, pp 356-363) SITING EVALUATION OF A NUCLEAR POWER PLANT IN SOUTHERN ISRAEL. Donagi, A.; Feige, Y.; Mamane, Y.; Argaman, Y. (Technion-Israel Inst. of Tech., Haifa). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

An investigation of the feasibility of building a nuclear power plant before 1980 along the southern Israel seashore was carried out. The various engineering, economic, ecological, and public aspects of the problem were analyzed. The feasibility of a nuclear power plant depends upon economic and environmental factors as well as the need for diversification of the power production sources. Israeli power production capacity at present is relatively small. However, with the expected increase in total generating capacity and constantly rising oil prices, a nuclear power plant of about 400 to 500 MW capacity (or a somewhat larger one in the event of a combination of power production and desalination) could be included in the conventional network. Other factors that may influence the decision are as follows: scarcity of potential sites along the seashore, the level of various pollutants in the air, and the sensitivity of the Israeli public toward the installation of conventional and nuclear power plants. The relative importance of the various factors was weighed and analyzed. Local ecology experts are all in agreement that a nuclear power plant is environmentally preferable. (auth)

26826 (COO-2371-2) BOTANICAL INVENTORY OF THE ROCKY FLATS AEC SITE. Final Report. Weber, W. A. (Colorado Univ., Boulder (USA)). 31 Jul 1974. Contract AT(11-1)-2371. 42p. Dep. NTIS $5.25.

An inventory of the vascular plants, bryophytes, and lichens occurring naturally on the Rocky Flats Site is presented that includes 327 species of vascular plants, 25 lichens and 16 bryophytes, and one macroscopic green alga. The floristic spectrum represents a residual tall-grass-prairie, short-grass plains, ponderosa pine woodland, and foothill ravine flora which has been extremely depauperated by human activity dating back to aboriginal activity, involving fire, overgrazing, timber-cutting, road-building, and other modern disturbances. Introduced Eurasian weeds constitute a significant percentage of the flora. The disturbance of the area has been accelerated by the characteristic high-wind activity of the site. (auth)

26827 (COO-3573-8, pp vp 12p) FATES OF MANGANESE, IRON, AND URANIUM DECAY SERIES NUCLIDES IN THE SUSQUEHANNA RIVER SYSTEM. Lewis, D. M. 1 Apr 1974.

In trace elements in natural waters.

A study was performed to determine what properties of a river control the fate of trace metals down its course and to define the form of these metals ultimately supplied to the estuarine environment. Manganese and iron were the trace elements measured in samples of Susquehanna River waters and sediments. Future assaying will determine the amounts of trace elements of the uranium decay series. The sampling and measuring procedures are described. Water pH, water temperature, and air temperature measurements were made concurrently with sampling. Analysis of the sediment data showed that: iron concentration in both dissolved and particulate phases does not vary greatly along the course of the Susquehana or its tributaries; in June 1973 the suspended sediment contained significantly higher concentrations of Mn than in sediments sampled in April 1973; and the amount of Mn lost downstream from solution is accounted for by the downstream increase in the particulate Mn concentration. (LCL)

26828 (COO-3573-8, pp vp 33p) DISTRIBUTION OF ^{238}U, ^{234}U, ^{226}Ra, ^{210}Pb, AND ^{210}Po IN WATER AND PLANKTON OF LONG ISLAND SOUND. Benninger, L. K. 1 Apr 1974.

In trace elements in natural waters.

In order to evaluate the extent to which estuarine environments affect the flux of metals to the deep ocean it is desirable to use time-dependent tracers such as natural ^{238}U, ^{234}U, ^{226}Ra, ^{210}Pb, and ^{210}Po as tracers of the pathways of metals. Therefore, plankton and water samples were taken in Long Island Sound off the Connecticut shore and analyzed for content of these radioisotopes. The sampling and analysis methods are described, and tabulated results are presented. (LCL)

26829 (DOCKET-701257-7) URANIUM OXIDE FUEL PLANT. License Application, Environmental Report, Amendment 14. (Exxon Nuclear Co., Richland, Wash. (USA)). 26 Jul 1974. 97p. Dep. NTIS $8.00.

The incremental environmental impact of installing and operating a uranium scrap reprocessing facility at the Exxon Nuclear Corporation's Uranium Oxide Fuel Plant at Richland Washington is discussed. The scrap reprocessing facility is planned to operate at a 1.4 ton/d capacity. An additional process chemical waste lagoon would be built near the facility. Information is included on: the site; plant operation; waste confinement and effluent control; effects of site preparation, and plant construction and operation; effects of accidents; monitoring programs; social and economic effects; and cost-benefit analysis. (LCL)

26830 (ORO-4328-3) ECOLOGICAL EFFECTS OF NUCLEAR SYSTEM ELECTRIC STATION OPERATIONS ON ESTUARINE SYSTEMS. Third Progress Report. Mihursky, J. A. (Maryland Univ., Solomons (USA). Natural Resources Inst.). Jun 1974. Contract AT(40-1)-4328. 359p. Dep. NTIS $21.00.

Field investigations of the estuarine environment near the Calvert Cliffs power reactor site in the Western shore zone of the Chesapeake Bay in Calvert County, Maryland are reported. These investigations were begun in 1971 to obtain pre-operational base line environmental and biotic data for the estuarine area. Information is included on: water quality; radionuclides; phytoplankton; zooplankton; meroplankton; benthic animal-sediment; and benthic-heavy elements. (LCL)

Thermal Effluents

Refer also to abstract 26836.

26831 (ORNL-TM-4180) SOURCES OF POTENTIAL BIOLOGICAL DAMAGE FROM ONCE-THROUGH COOLING SYSTEMS OF NUCLEAR POWER PLANTS. Goodyear, C. P.; Coutant, C. C.; Trabalka, J. R. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 46p. Dep. NTIS $5.50.

General sources of potential biological damage from once-through cooling systems of steam electric nuclear power plants are briefly described. These sources include temperature changes, mechanical and pressure changes, impingement on intake screens, chemical toxicity of biocides, changes in dissolved oxygen, induced circulation, radiation, and combinations of all of these. Other sources of damage may arise at particular power plant sites. All of these need to be carefully considered and their effects predicted when making power plant environmental impact assessments. (auth)

26832 (ORNL-tr-2763) DYNAMICS OF THE WATER TEMPERATURE OF THE IVANKOVSK RESERVOIR IN THE ZONE OF ENTRANCE OF THE HEATED WATERS FROM THE KONAKOVSK POWER STATION. Butorin, N. V.; Kurdina, T. N. Translated by E. J. Zuckerman from Biol. Vnutr. Vod, Inform. Byull.; No. 7, 69-73(1970). 6p. Dep. NTIS $4.00.

During five days in May 1968, a program was undertaken to study the temperature distribution and temperature dynamics in the area of the Ivonkovsk Reservoir which receives heated water discharged from the Konakovsk power plant. Measurements were made of water temperature, speed and direction of the water current, air temperature, and wind speed and direction. The observations indicated that the rise in the average temperature of the water was from 1.5°C to 3.4°C, depending on the measurement point, and that meteorological conditions, particularly wind, play a decisive role in the water temperature dynamics. (LCL)

26833 (ORNL-tr-2771) TIME AND THE DURATION OF THE SPAWNING PERIOD OF MASS FISHES IN THE RESERVOIR-COOLER OF THE LITOVSK POWER STATION. Astrauskas, A. S. Translated by E. J. Zuckerman from Biol. Vnutr. Vod, Inform. Byull.; No. 11, 55-58(1971). 4p. Dep. NTIS $4.00.

Data are presented on the water temperature increase in the reservoir which receives cooling water from the Litovsk power plant and on the time and duration of spawning of several major species of fish in the reservoir. It is shown that the initiation and duration of spawning in water heated by the plant effluents varies with the fish species and that the temperature at the time of spawning and egg development does not exceed lethal boundaries. It is concluded that the stabilized warmer temperature conditions in the spawning grounds permit an increase in the effectiveness of the reproduction of the fish population. (LCL)

26834 (ORNL-tr-2778) BENTHIC FAUNA OF THE IVAN'KOVSKI WATER RESERVOIR IN THE REGION OF HOT-WATER DISCHARGE FROM THE KONAKOVSK THERMOELECTRIC STATION. Poddubanaya, T. P. Translated from Tr., Inst. Biol. Vnutr. Vod, Akad. Nauk SSSR; 21: No. 4, 96-103(1971). 9p. Dep. NTIS $4.00.

The effects of hot water discharged by the Konakovsk thermoelectric plant on the benthic fauna of the Ivan'kovsk water reservoir was studied. It was concluded that the discharge of the Konakovsk heated water into the Ivan'kovsk reservoir in 1967-1968 did not cause any abrupt changes in the species composition of the bottom fauna or its distribution by biotope. The increase in temperature of the bottom layers of water and the soil in a large part of the reservoir in winter and early spring, an average of 7°C, shifted the reproduction time of tuboficids and the emergence of the imago in chironomids. These processes occurred a month earlier. The tuboficid Limnodrilus hoffmeisteri gave additional generations of young, as a result of which there was an increase in the numbers of the population. The data agree with the results of 1967 observations made on the Ukrainian flowing storage-cooler where even the relatively small additional heating results in increase in the number of bottom fauna. A further increase in the volume of discharged water from the Konakovsk thermoelectric plant (from 30 to 50 m^3/sec) results in distribution of its effects more widely and will allow determining the new type of dynamics of population of bottom fauna and the increase in their number. (LCL)

26835 CONTAMINATION OF THE ENVIRONMENT BY THERMAL POWER STATIONS AND THE TECHNICAL POSSIBILITIES OF ITS ELIMINATION. Heller, L. Acta Tech. Acad. Sci. Hung.; 75: No. 1-4, 185-192(1973).

According to the second law of thermodynamics about 60 to 70% of the thermal energy introduced in the form of fuel will in practice be dissipated as heat loss when thermal energy is transformed into mechanical power. Due to the rapid increase in the rate of electric power consumption (doubled every 10 y on a world average) the heat loss load of the atmosphere is becoming a serious problem. The bulk of these losses is carried away by coolants as the heat loss of the involved thermal cycles. The effects of the most commonly used cooling systems impairing the environment are described and an explanation is given of how the application of air condensation eliminates the disadvantages of the cooling systems employed so far. The possibilities of reducing air pollution by thermal power stations through the use of air condensation are discussed. (Hung. Tech. Abstr.)

Chemical Effluents

Refer also to abstracts 26328, 26757, 26774, 26775, 26820, 26821, 26831, and 28850.

26836 (CONF-740555-1) COMPARISON OF THE ENVIRONMENTAL ASPECTS OF NUCLEAR AND FOSSIL FUELLED POWER STATIONS. Holy, Z. J. (New South Wales Univ., Kensington (Australia). School of Nuclear Engineering). 1973. 9p. Dep. NTIS (US Sales Only) $4.00.

From annual engineering conference; New South Wales, Australia (20 May 1974).

Two of the major problems facing our society today are the growing demands for energy and the pollution associated with its generation. World reserves of fossil fuels alone will not meet these demands, and it is obvious that other power sources, such as nuclear fission, must supplement the combustion processes currently used. The major environmental hazards associated with both fossil fueled and nuclear power stations are discussed, using data both from Australia and overseas. The environmental and biological effects of air pollution, thermal pollution, radioactive effluents from power stations and fuel reprocessing plants, and radioactive waste disposal are dealt with, and the safety of nuclear power stations discussed. Two methods are outlined for the comparison of hazards associated with fossil fired and nuclear plants, and one of these is used in the analysis. This is not an exhaustive study of the subject, but rather indicates the major points of concern and illustrates a possible approach using a simple model for such environmental comparisons. (auth)

26837 (DP-1359) DISPOSAL OF FLUORINE BY REACTION WITH CHARCOAL. Kelley, J. A. (Du Pont de Nemours (E. I.)

and Co., Aiken, S. C. (USA). Savannah River Lab.). Aug 1974. Contract AT(07-2)-1. 15p. Dep. NTIS $4.00.

Tests were made to determine the type of charcoal and operating parameters best suited for fluorine disposal. Nonactivated wood charcoal was found to be safe in operation, and heating of the charcoal to ~300°C was necessary for efficient reaction of fluorine. At low fluorine concentrations (<25% F_2 in the gas stream), the principal reaction product is a white fluorocarbon smoke. CF_4 is the principal product with 100% fluorine. A small amount of condensable fluorocarbons is formed by the fluorine-charcoal reaction. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 27056 and 27094.

General Detectors and Monitors

Refer also to abstracts 26415, 27021, 27083, 27086, 27286, 28490, 28596, 28708, and 28726.

26838 (AED-CONF-74-157-001) MONITORING RADIOACTIVE EFFLUENTS BY LARGE AREA PLASTIC SCINTILLATORS. A Possibility for Standardization. Barz, H. G.; Borchardt, K. D.; Hacke, J. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Abt. Strahlenschutz). 1974. 9p. INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

3 figs.; 2 tabs.; 2 refs. With abstract in English and German.

The monitoring of radioactive effluents released from a 5 MW swimming pool reactor is described. Plastic scintillation detectors mounted in special bypass chambers are used. Data are given regarding calibration and sensitivities for β-particles and γ-radiation. The activity concentration as well as the total activity released can be determined directly. If necessary, background reduction can be obtained by use of a conventional compensation method. The advantages of plastic scintillation detectors compared with GM-tubes are discussed. (auth)

26839 (CEA-R-4576) EXPERIMENTAL EVALUATION OF AN X-RAY DETECTOR SENSITIVITY TO 1- TO 20-keV PHOTONS. Chollet, J. P.; Colin, J.; Gouin, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). Jul 1974. 28p. (In French). Dep. NTIS (US Sales Only) $4.50.

An experimental technique to measure an x-ray detector sensitivity at low energies is described. The detector parts are a 56 DVP photomultipliers associated with a fast plastic scintillator (SPF or NE 104). The monochromatic x ray machine and the arrangement especially built for this purpose are described with details. Figures and tables summarize calibration results. (auth)

26840 (CONF-730907-P2, pp 852-856) CELLULOSE NITRATE PLASTIC FILM: ITS PREPARATION AND APPLICATIONS IN HEALTH PHYSICS. Bhagwat, A. M.; Soman, S. D. (Bhabha Atomic Research Centre, Bombay). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The standardization of cellulose nitrate (C.N.) films (thickness $\approx$3.0 mg/cm^2) for the detection of alpha particles from a ^{239}Pu source and some of its applications are discussed. The etchant used was 6 N NaOH. The optimum etching time for the development of tracks was found to be 4.5 hours at room temperature (24 to 25°C). The track formation efficiency under these conditions works out to be 17.9%. Results of some studies are included. It is now possible to detect low alpha activities of the order of 10^{-3} dpM, thereby making many types of extremely low level alpha measurements possible. (auth)

26841 (CONF-730907-P2, pp 920-925) LONG-TERM MEASUREMENTS OF RADON DAUGHTER ACTIVITY IN MINES. Haider, B.; Jacobi, W. (Gesellschaft fuer Strahlen und Umweltforschung mbH, Munich). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A rugged, portable filter monitor for the long-term measurement of Rn-daughter activity in mines with direct indication of the cumulative exposure is described. The monitor is equipped with rechargeable batteries and enables continuous or fractionated air sampling at preset time intervals over a period of 1 to 2 weeks with one battery charge. The results of continuous measurements over a one-year period in a fluorspar mine are discussed. (auth)

26842 (CONF-730907-P2, pp 932-938) RADON DAUGHTER MONITOR FOR USE IN MINES. James, A. C.; Strong, J. C. (National Radiological Protection Board, Harwell, Eng.). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A self-contained monitor for the measurement of airborne RaA, RaC and the working level, WL, in the shortest practicable time and with a minimum of calculation is described. The ratio of two gross alpha-counts gives, directly, the ratio of airborne alpha-emitter concentrations, RaC$'$: RaA, after collection on a filter. This is achieved because the contribution from airborne RaB to the measured alpha-activity is minimized by choosing short sampling and counting times. The RaA concentration is derived from the first alpha-count, during air sampling. WL is derived from the second alpha-count. No background correction is required. Systematic errors in estimated quantities are small. With a total measuring time of eleven minutes, the limits of detection are approximately 1 pCi/liter for RaA and 10^{-4} for WL. (auth)

26843 (CONF-730907-P2, pp 957-962) MONITORING OF LOW-ENERGY RADIONUCLIDE CONTENT IN HUMAN BODY. Dolgurev, E. I.; Kaidanovskii, G. N.; Porozov, N. V.; Shamov, V. M. (Inst. of Radiation Hygiene, Leningrad). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A 15 cm -dia 0.1 cm thick NaI detector and an Ar-CH_4 proportional counter with a 300 cm^2 window are used for in vivo measurements of ^{210}Pb, ^{239}Pu and ^{241}Am content in the human body. The subject's background was determined from the correlation of the counting rates in two channels, e.g. for ^{210}Pb: 30 to 55 and 100 to 150 keV, respectively. The detectors were calibrated on an anthropomorphous phantom with a thickness of the tissue absorption layer varying from zero to 4 cm. Calculation methods for nuclide content in critical organs and cases illustrating different types of radionuclide distribution in the human body are given. (auth)

26844 (CONF-730907-P2, pp 969-975) METHODS OF ABSOLUTE CALIBRATION OF EQUIPMENT FOR MEASUREMENT OF ^{210}Pb, ^{239}Pu AND ^{241}Am IN HUMAN BODY. Dolgurev, E.; Kaidarovskii, G. N.; Porozov, N. V.; Shamov, V. P. (Inst. of Radiation Hygiene, Leningrad). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Calibration of detectors designed for in vivo measurements of ^{210}Pb, ^{230}Pu and ^{241}Am in human body was made by means of an anthropomorphous phantom. Absorption of low energy photons (13 to 60 keV) in materials simulating various biological tissues was studied. The calibration coefficients for the fat tissue (Z = 5.9) were 3 times as high as those for the muscular one (Z = 7.4), when the tissue thickness was 2 cm. In this connection, the distribution and ratio of the said tissues in the human body were studied, using a group of 30 men. In calibration phantom measurements, a tissue equivalent material simulating the biological tissue with 22% of fat tissue and 78% of muscular one was used. Detectors have been calibrated for measurements in the energy bands: 10 to 25 keV ^{239}Pu, 30 to 55 keV, ^{210}Pb, 10 to 25 keV and 35 to 70 keV ^{241}Am and tissue absorber thicknesses in the range from 0.5 to 4 cm. The effect of such factors as variations in the shape and location of body organs, radiations of isotopes deposited in the skeleton, and some others was taken into account. (auth)

26845 (CONF-730907-P2, pp 979-984) ASSESSMENT OF PLUTONIUM IN HUMAN LUNGS WITH THIN NaI(Tl) DETECTOR SYSTEMS. Sharma, R. C.; Somasundaram, S.; Surendran, T.; Kapur, D. K.; Garg, S. P. (Bhabha Atomic Research Centre, Bombay). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The development of detector systems for assessment of inhaled plutonium-americium dust deposited in human lungs by direct detection of externally emitted low-energy photons is a continuing program at Trombay. This paper describes the work done with thin NaI(Tl) scintillation detector systems. The background data inside the Trombay steel room in different low-energy bands for crystals

of thicknesses 1, 2 and 5 mm are presented. To study the capabilities of three detector systems, each consisting of a set of crystals of the same thickness, a realistic chest phantom of an Indian adult was designed and employed. The chest phantom was constructed from a rib cage of an Indian adult enclosed in a hard polythene cover provided to simulate the chest profile. Measurements on absorption and scattering of low-energy photon (17, 22 and 60 keV) by four constructional materials were made to verify their degree of equivalence to human tissue and granular sugar was used as tissue equivalent material in phantom construction. The counting efficiences and limits of detection of three detection systems for point sources of plutonium distributed in the central plane of each simulated lung of the designed phantom are reported. A few normal subjects were counted with one detector system and the increase in background in the low-energy region was investigated. The natural radioactivity of the subjects was monitored with a (20.32 cm dia. × 10.16 cm thick) NaI(Tl) crystal in a 50 cm Arc Chair. Finally, the effect of body build of a subject on the counting efficiency of plutonium is commented on and the future program is briefly indicated. (auth)

26846 (CONF-730907-P2, pp 991-998) IN-VIVO MONITORING OF NUCLEAR FUEL WORKERS. Pomroy, C.; Gordon, J.; Letourneau, E. G. (Dept. of National Health and Welfare, Ottawa). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Results of performance tests on a portable whole-body counter for monitoring nuclear fuel workers are presented. The detector is a 3 mm thick by 20 cm diameter NaI(Tl) scintillation detector. It is concluded that given certain conditions the NaI(Tl) crystal with portable shielding can detect lung burdens in the region of 30 mg natural U. The conditions are that only natural U is present in equilibrium with its thorium daughters and that no separated thorium is present. (WHK)

26847 (CONF-730907-P2, pp 999-1004) APPLICATION OF PHOSWICH DETECTORS FOR LUNG COUNTING PLUTONIUM-238. Tomlinson, F. K.; Brown, R.; Anderson, H.; Robinson, B. (Mound Lab., Miamisburg, OH). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Mound Laboratory's Whole Body Counter was designed and calibrated for the detection of ^{238}Pu in the lungs. The basic counting program since December 1969 is summarized. The primary discussion is centered around the phoswich detection system. A unique triple coincidence pulse shape discrimination technique was used to reduce the background more than one order of magnitude as compared to a standard NaI(Tl) detector. Detection limits are given as a function of the subject's tissue thickness between the lungs and detectors. For a typical subject with an effective tissue thickness of 2.3 cm over the lungs, the system has a detection limit of 4 nCi. (auth)

26848 (CONF-730907-P2, pp 1005-1010) CHESTWALL TISSUE MEASUREMENTS FOR LUNG COUNTING APPLICATIONS. Tomlinson, F. K.; Brown, R.; Anderson, H.; Robinson, B. (Mound Lab., Miamisburg, OH). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Mound Laboratory's Whole Body Counter was designed and calibrated for the detection of ^{238}Pu in the lungs. Quantitative measurements depend upon the detection of the 17 keV (average) x ray associated with the decay of ^{238}Pu. Because the half-value layer for 17 keV x rays in tissue is only 6 to 7 mm, the effective thickness of the tissue overlaying the lungs must be accurately determined for proper interpretation of the counting data. The tissue thickness over the lungs is determined by ultrasonic measurements over the second, third, and fourth rib in the manner suggested by Ramsden, Peabody and Speight. A review of the instrumentation and technique used at Mound Laboratory to obtain the tissue thickness measurement based on experience in making these measurements on more than 700 different persons is given. (auth)

26849 (CONF-730907-P2, pp 1422-1427) INSTRUMENTS AND METHODS FOR DAY-TO-DAY MONITORING OF TRITIUM AND CARBON-14 IN PRODUCTION. Balonov, M. I.; Dolguirev, E. I.; Karasik, A. S.; Prokofiev, O. N. (Inst. of Radiation Hygiene, Leningrad). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A complex of instrumentation and techniques for dosimetric monitoring at industrial enterprises using unshielded beta-emitters of T and ^{14}C is described. Airborne radionuclides are assayed by automatic monitors developed on the basis of gas counters. A portable device for detection of radioactive contamination of surfaces is described. Scintillation and gas counters have been used to measure ^{14}C and T content in personnel. The sensitivity of the methods is sufficient for monitoring of all categories of exposure. (auth)

26850 (CONF-730907-P2, pp 1428-1433) SAMPLING FOR TRITIATED WATER VAPOR. Osborne, R. V. (Chalk River Nuclear Labs., Ont.). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Collection of tritiated water vapor $(HTO)_V$ from air by bubbling the air through non-tritiated water and subsequent measurement of the accumulated activity by liquid scintillation counting is often used as a simple method of monitoring for $(HTO)_V$ in air. Expressions for the collection efficiency of a model collecting device of this kind are derived here in terms of the initial mass of water in the collector, the total air flow, the humidity in the air entering and leaving the collector, the intrinsic efficiency of the collector and the ratio of the relative isotopic concentration [T/H] in the vapor phase to that in the liquid phase at the effective operating temperature of the device. Predictions from the model are compared to the measured efficiencies of collectors with and without fritted glass air dispersers, for water masses from 50 g to 200 g, air volumes 0.1 to 20 m^3, air flow rates up to 160 cm^3/s and water temperatures in the range 5 to 35°C. Intrinsic efficiencies greater than 95% and agreement between predictions and results to within a few percent are demonstrated for a practicable range of the variables. (auth)

26851 (CONF-730907-P2, pp 1434-1439) RUGGEDIZED ULTRASENSITIVE FIELD AIR SAMPLER FOR DIFFERENTIALLY DETERMINING TRITIUM OXIDE AND GAS IN AMBIENT AIR ATMOSPHERE. Brown, R.; Meyer, H. E.; Robinson, B.; Sheehan, W. E. (Mound Lab., Miamisburg, OH). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The instrument described is an operational, practical, ruggedized, ultrasensitive, tritium field air sampler assembled for the simultaneous, differential sampling of the environmental air for tritium oxide and elemental tritium. The system uses hardware assembled and packaged in such manner as to facilitate use in the field as well as in the laboratory. The sampling system occupies a relatively small space and is simple to operate. The detection sensitivity approaches tritium background levels and is achieved by high volume sampling, efficient removal of tritium oxide and elemental tritium ("tritium gas"), and counting the recovered fractions by liquid scintillation spectrometry. (auth)

26852 (CONF-730907-P2, pp 1452-1457) HIGH ENERGY PHOTON DETECTION BY FISSION TRACK REGISTRATION. Iida, H.; Koshijima, T. (National Inst. of Radiological Sciences, Chiba, Japan). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

An attempt was made to detect high-energy photons above 5 MeV by a photofission reaction. A solid state fission track detector, in which one face of a solid block was coated with fissionable material, was used as a high energy photon detector. Typical results obtained with bremsstrahlung at maximum energy of 29 MV are as follows. Fission track density per 100 R was found to be about 1,000 tracks/cm^2. The number of high-energy photons over 5 MeV per 100 R from the total bremsstrahlung was estimated to be 4×10^9/cm^2, assuming that the effective cross section of natural uranium is approximately 0.05 barn for the bremsstrahlung. The track detector presented may provide a useful means to detect high energy photons even in the presence of other radiations except neutrons, and is expected to be utilized for the monitoring of high-energy photons. (auth)

26853 (CONF-730907-P2, pp 1458-1463) INEXPENSIVE LIGHTWEIGHT ENVIRONMENTAL SURVEY INSTRUMENT. Thompson, I. M. G. (Central Electricity Generating Board, Berkeley, Eng.); Orchard, H. C. Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The operation of power reactors in the U.K. involves a statutory requirement to measure radiation levels in the area surrounding each nuclear site. The natural radiation background is measured at specified locations prior to operation of the reactor and afterwards routinely every three months. A survey instrument used for such measurements must therefore measure exposure levels from background (typically a few $\mu R.h^{-1}$ in the U.K.) upwards. Other requirements for the instrument are that it should be very portable, be capable of being read accurately at low exposure rates, and should maintain its calibration. The G-M detector system described weighs only 10 lbs, has a good energy response (±15% over the range 50 keV to 6 MeV) and measures exposure levels from a few $\mu R.h^{-1}$ to 100 $mR.h^{-1}$. Ambiguities resulting from reading a fluctuating meter needle at low exposure rates are overcome by integrating the count over a preselected time, digital readout being provided. A comprehensive evaluation of the instrument and its comparison with other commercially used instruments is given. The instrument price is considerably cheaper than that of comparable instruments. (auth)

26854 (CONF-730907-P2, pp 1470-1475) CONDUCTIMETRIC PROPERTIES OF SOME SOLID TRACK DETECTORS AND HYPOTHESIS ON THE TRACK FORMATION MECHANISM IN THESE IRRADIATED AND ETCHED DETECTORS. Martin-Borret, Y.; Bourdeaux, M.; Roux, F.; Briand, C. (Faculte de Pharmacie, Marseille). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The purpose of the work was to study the conductivity variations of solid track detectors with ester function after etching and irradiation. The different conductimetric behavior of these detectors allows to assume the chemical etching mechanism. This hypothesis seems to be confirmed by IR and RMN studies. All the papers about latent track formation in solid track detectors point out the following condition: detectors must have electrical resistivity above 2000 Ω/cm to record any track formation. So it is interesting to study the conductimetric properties of these insulators and especially the variation of their resistivity as a function of irradiation dose, etching time and concentration of etching reagent. For this purpose, cellulose esters and polycarbonate films were studied. (auth)

26855 (RFP-2304) SINGLE CHANNEL PULSE-HEIGHT ANALYZER WITH READOUT. Martin, B. E. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 22 Aug 1974. Contract AT(29-1)-1106. 16p. Dep. NTIS $4.00.

The single channel pulse-height analyzer described is housed in a one-wide Nuclear Instrumentation Bin (NIM-BIN) module. The design uses the latest COS/MOS (complementary symmetry metal-oxide semiconductor) integrated circuits (IC) featuring low power, low cost, and high reliability. The module was developed specifically for isotopic identity in radiation-detection systems. (auth)

26856 (TID-26636) STUDY OF THE PULSE-HEIGHT RESPONSE OF SILICON SURFACE-BARRIER DETECTORS TO HIGH-ENERGY HEAVY IONS. Smith, G. D. (Missouri Univ., Rolla (USA)). 1973. 138p. Dep. NTIS $10.00.

Thesis.

The pulse-height defect (PHD) of high-energy heavy ions in silicon surface-barrier detectors can be divided into three components: (1) energy loss in the gold-surface layer, (2) a nuclear-stopping defect, and (3) a defect due to recombination of electron-hole pairs in the plasma created by the heavy ion. The plasma recombination portion of the PHD was the subject of this study using the variation of the PHD with (1) the angle of incidence of incoming heavy ions, and (2) changes in the detector bias. The Tandem Van de Graaff accelerator at Argonne National Laboratory was used to produce scattered beam ions (^{32}S, ^{35}Cl) and heavy target recoils (Ni, Cu, ^{98}Mo, Ag, Au) at sufficient energies to produce a significant recombination defect. The results confirm the existence of a recombination zone at the front surface of these detectors and the significance of plasma recombination as a portion of the pulse-height defect. (86 references) (auth)

26857 (UCID-15381) LARGE AREA, R.F. LINKED, GAMMA RADIATION MONITORING SYSTEM WITH CENTRALIZED DATA RECORDING. Nish, G.; Phelps, P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jul 1968. 16p. Dep. NTIS $4.00.

The development and layout of a system for recording gross gamma radiation over several hundred square miles of land which could be modified for use in the atmosphere and at sea are described. The components of the proposed ground system are: gamma ray sensing stations, rf repeater stations, and a centrally located data collecting trailer. Cost and manpower estimates are given. (WHK)

26858 (UCID-15538) PAINTING PROCESS FOR MAKING FISSION FOILS. Behrens, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Oct 1969. 11p. Dep. NTIS $4.00.

Fission ionization chambers usually contain fissionable material in the form of a thin oxide coating with a thickness between 0.2 and 2.00 mg/cm^2. Fission foils are produced by painting nickel substrates with coats of nickel-natural uranium. Equivalent U_3O_8 areal densities as large as 1.3 mg/cm^2 were obtained, although this process is not necessarily limited to these thicknesses. The foil coatings were uniform to about 4% over the 24-cm^2 area of these particular foils. They have shown excellent adhesion to date. The foils were tested for percentage of uranium in the coating and separation of alpha-particle and fission-fragment pulse heights. The cost of this painting technique was estimated to be approximately one-tenth the cost of producing foils by evaporation, electrodeposition, or sputtering techniques. (auth)

26859 (UCRL-75891) SUB-KILOVOLT X-RAY CALIBRATION OF PHOTOGRAPHIC FILM. Koppel, L. N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jul 1974. 15p. (CONF-740809-6). Dep. NTIS $4.00.

From 23rd annual conference on applications of x-ray analysis; Denver, Colorado, USA (7 Aug 1974).

The x-ray spectroscopy of laser-generated plasmas can be applied to photon energies of less than 1 keV, provided calibrations of the response of energy discriminators and detectors are performed in the sub-kilovolt region. Photographic film was used to monitor the intensity of radiation dispersed by a curved lead stearate crystal. The response to sub-kilovolt x-rays of two types of film, Kodak No-Screen and the special vacuum ultraviolet Kodak type 101-01, was determined. This calibration was obtained by exposing samples of film to continuous beams of nearly monochromatic characteristic radiation from an array of targets. The fluorescent radiations were the K series of carbon and magnesium and the L series of titanium, nickel, cobalt and copper. The response data are presented as a series of characteristic curves, plotting for each film type and photon energy the net diffuse photographic density as a function of the photon flux incident on the film. The processing of all film was in accordance with the manufacturer's suggestions. The accuracy and reproducibility of these data are characterized. The data demonstrate the greater sensitivity of the type 101-01 to sub-kilovolt x-rays. The intensity and spectral purity of the incident fluorescent beams were monitored by a thin-window gas proportional counter that used flowing propane gas at sub-atmospheric pressures. The procedures and results of a determination of the quantum efficiency of this counter as a function of photon energy are described. (auth)

26860 INDIUM ANTIMONIDE DETECTORS OF NUCLEAR RADIATION AT 77°K. Volkov, A.S.; Petrushina, Z.A.; Saimkulov, Z.A.; Strokan, N.B.; Tisnek, N.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.—Semicond. 7: No. 9, 1175-1178 (Mar 1974).

Indium antimonide detectors were developed for γ rays. Deep levels of structure origin and of density not less than $2 \cdot 10^{14}$ cm^{-3} were found in the forbidden band of indium antimonide. These levels made it impossible to construct indium antimonide counters which would operate at 77°K on the traditional basis of charge collection from the high-field region in a reverse-biased p—n junction. Therefore, InSb detectors were based on a different charge-collection mechanism, which was the ambipolar diffusion of nonequilibrium electron-hole pairs from the base to the p—n junction. The technology for the fabrication of diffused p—n junctions was developed. The spectra of α particles of a radiothorium specimen were recorded: They included a line at 8.78 MeV and a group of five lines between 5.42 and 6.77 MeV. The γ-ray spectra of Co^{57} were also recorded. An estimate of the collected charge was in agreement with the hypothesis that the effective energy of formation of a pair in InSb was less than 2 eV. An analysis was made of the optimal construction of a detector ensuring a better charge collection than a single p—n junction. The form of the amplitude spectrum was calculated. (auth)

26861 INCREASING THE SENSITIVITY OF SURFACE-BARRIER PHOTORECEIVERS. Groshkova, G. N.; Zakharchuk, O. V.; Koltun, M. M.; Fedoseeva, O. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 54-56(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 57-58(1974).

The sensitivity of surface-barrier Si–Au photoreceivers is increased by clarifying a gold film with coatings of TiO_X and Cr + SiO_2. It is shown that these coatings allow the reflection to be reduced by 65% in the spectral range from 0.4 to 0.8 μ and the transmission coefficient to be raised to 70% in this range. The results of the work make the application of the considered diodes in a scintillator-detector system for recording nuclear radiation a reality. (auth)

26862 SEMICONDUCTOR DETECTOR OF PULSED HIGH-INTENSITY GAMMA RADIATION. Vorob'ev, V. V.; Afanas'ev, V. N.; Khokhryakov, V. F. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 51-53(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 55-57(1974).

A semiconductor detector for pulsed high-intensity γ radiation is described which is based on an irradiated batch-manufactured KD104A diode. The detector is suitable for measurement of γ fluxes of up to $(2 \text{ to } 5) \cdot 10^{19}$ MeV/cm^2 · sec. (auth)

26863 AUTOMATIC MICROPHOTOMETER ON A LINE WITH AN ELECTRONIC COMPUTER: PROCESSING OF BETA SPECTROGRAMS. Vylova, L. A.; Zalite, V. A.; Iskhakov, G.; Levchanovskii, F. V.; Potempa, M.; Prikhod'ko, V. I.; Revenko, A. V.; Stakhura, Z.; Tsupko-Sitnikov, V. M. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 63-67(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 64-67(1974).

Based on an industrial MF-2 microphotometer an instrument (AMF) was fabricated for the automatic continuous photometry of objects. The light flux that passes through the object is recorded by a photomultiplier whose signal is coded by an amplitude-digital converter and is entered directly into the memory of the "Minsk-2" computer. The maximum number of readings recorded during one pass is 16,000. The handling rate is 4 mm/sec (80 readings in a step of 0.05 mm, and 160 readings in a step of 0.025 mm). The instrument is used to handle β spectrograms obtained on magnetic spectrographs. The total handling cycle for one spectrogram (400 mm), which consists in the sequential scanning of the photographic plate along five tracks, the programmed combination of the results of five passes, averaging, and scaling from the optical to the electronic density, occupies about 20 minutes. (auth)

26864 CURRENT-FREQUENCY CONVERTER FOR OPERATION WITH AN IONIZATION CHAMBER. Zinov, V. G.; Krasnoborodov, B. S. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR).(Engl. Transl.); 17: No. 1, 92-93 (1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 89-90(1974).

A current-frequency converter is described in which the charge stored in the batching capacitor is compensated by the current of the output pulses. The circuit allows connection of a long cable between the ionization chamber and the electronic section of the instrument. This allows utilization of the converter for operation in powerful radiation fields. (auth)

26865 PULSE GENERATOR WITH AUTOMATIC AMPLITUDE STABILIZATION. Breido, V. L.; Romanov, L. R.; Darovskikh, V. F. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 112-115(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 104-107(1974).

A generator is described which produces pulses having a stable amplitude and is implemented according to the principle of automatic control devices; the generator ensures independence of the amplitude of the output voltage from the load current in the range from 0 to 600 mA. The relative variation of the amplitude in the indicated load-current interval does not exceed 0.4% in the 0 to 50°C temperature range. The amplitude of the output pulse can be controlled smoothly in the range from 1 to 10 V. The generator is used in systems for the stabilization of the measurement channels of scintillation detectors for supplying semiconductor light sources. (auth)

26866 SCINTILLATION GRANULES IN THE COINCIDENCE METHOD. Seredenko, T. N.; Solomonov, V. M.; Tsirlin, Yu. A.; Ekkerman, V. M. (All-Union Scientific-Research Inst. of Single Crystals, Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 59-62(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 61-63(1974).

The important practical case of the recording of β radiation from nuclides situated in liquid samples by means of scintillation granules based on the coincidence method is considered. The possibility of efficient recording of low-energy radiation from ^{14}C by this method is demonstrated. A calculation is presented which explains the experimentally observed effects–specifically the considerable drop in recording efficiency when granules having small dimensions are used. The dependence of the recording efficiency on the granule characteristics, the recording threshold, and the thickness of the measurement vessel is presented. (auth)

26867 INDEX TO COMPARE THE PERFORMANCE OF SCINTIGRAPHIC IMAGING SYSTEMS. Rollo, F. D. (Univ. of California, San Francisco). J. Nucl. Med.; 15: No. 9, 757-762 (Sep 1974).

The contrast-efficiency function is a suitable means of describing the spatial-resolution characteristics of a scintigraphic imaging system but cannot be used to describe total-system performance since it does not include the factor of plane sensitivity. The concept of performance index is presented as a measure of total-system performance. This function includes the system's spatial resolution in terms of the contrast-efficiency function and plane sensitivity as measured by statistical fluctuation. The index has special merit in that it measures how well a given system will reproduce a specific input problem in the image plane. Therefore, when used to compare the performance of various systems or to study the effect of varying a parameter within a given system, all comparisons are made on the basis of how well the systems in question are able to reproduce an object having specific geometry in the image plane for equal times of observation. The results of experimental studies show that for small lesion sizes, systems having high spatial resolution give the best performance whereas for large lesions, the system having the highest plane sensitivity gives the best results. For intermediate lesion sizes, the concept shows that the system having the optimum trade-off between spatial resolution and plane sensitivity for the lesion size evaluated gives the best performance. One problem, which is of minor importance, is that the index does not as yet include the effect of a change in MTF with distance off the focal plane. This effect will only be important when evaluating the performance of lesion detection when the size of the lesion is such that the MTF varies significantly over the source distance. Application of the performance index concept in future investigations includes the following: pulse-amplitude discrimination level studies on radioisotopes in clinical use; total-system performance studies of collimators available for scintigraphic imaging systems; and comparison of the systems performance of the various stationary scintigraphic imaging devices currently available. (auth)

26868 GAMMA-RAY IMAGING SYSTEM USING MODULATED APERTURES. Macovski, A. (Stanford Univ., CA). Phys. Med. Biol.; 19: No. 4, 523-533(Jul 1974).

A system is proposed for improved sensitivity, resolution and depth delineation in γ-ray cameras. An array of apertures was used to provide different views of the radiating sources. The aperture plate was between the source and the γ-ray detector. Each aperture was mechanically modulated at a different frequency so that its resultant image could be separated from the others. On reconstruction the individual images were demodulated by using the appropriate frequency. The individual images were translated and combined to view any section of the radiating sources. The noise problem and the requirements for orthogonality of the modulating signals are considered. (auth)

26869 REDUCTION OF COINCIDENCE LOSS IN RADIONUCLIDE IMAGING CAMERAS THROUGH THE USE OF COMPOSITE FILTERS. Muehllehner, G.; Jaszczak, R. J.; Beck, R. N. (Searle Radiographics Inc., Des Plaines, IL). Phys. Med. Biol.; 19: No. 4, 504-510(Jul 1974).

The use of a composite filter makes it possible, by selectively attenuating the input γ-ray intensity distribution, to reduce coincidence loss and thereby increase the observed count rate of an Anger type camera. A theoretical analysis is presented to assist in estimating the crossover count rate which is that count rate above which the composite filter will be useful, and below which it will be a hindrance. A source consisting of a vial of ^{99m}Tc within a scattering medium was used to obtain experimental data. Data are presented for a two layer filter consisting of a 0.23 mm thickness of tin and 0.13 mm of copper. This filter attenuated the primary 140 keV γ-ray by about 12%. The crossover count rate for this particular filter and with a 20% window was 46,000 counts s^{-1} (single-channel analyzer output). At very high input count rates the improvement in observed count rate was 15%. (auth)

26870 CHARGE COLLECTION CHARACTERISTICS OF AN AIR ION CHAMBER FOR 0.2 $_{1s}$ PULSES OF 25 MeV ELECTRONS. Kiker, W. E. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Phys. Med. Biol.; 19: No. 4, 484-494(Jul 1974).

The charge collection characteristics of a parallel-plate trans-

mission air ion chamber have been measured for 0.2 μs pulses of 25 MeV electrons over a range of initial charge densities from 0.6 to 430 esu cm^{-3}. Plate spacings of 0.07, 0.40, and 0.73 cm were used with E/p values of 1 and 6, 1, 3, and 6, and 1 and 3 V cm^{-1} $mmHg^{-1}$, respectively. Electron beam monitoring was done with a graphite Faraday cup. The results of the experiment were compared with calculated values of charge collection efficiency from a model that accounts for negative ion collection by means of Boag's theory and electronic charge collection by an empirical model. The relative proportion of negative ions to electron charge carriers was calculated from a theory due to Thomson and to Boag and Wilson. Charge collection efficiency as calculated from the model was in good agreement with experimental values. (auth)

26871 MULTIPLEX IMAGING WITH MULTIPLE–PINHOLE CAMERAS. Brown, C. (Department of Machine Intelligence, University of Edinburgh, EH8, 9NW, Scotland). J. Appl. Phys. 45: No. 4, 1806-1811 (Apr 1974).

When making photographs in x rays or γ rays with a multiple–pinhole camera, the individual images of an extended object such as the sun may be allowed to overlap; then the situation is in many ways analogous to that in a multiplexing device such as a Fourier spectroscope. Some advantages and problems arising with such use of the camera are discussed, and expressions are derived to describe the relative efficacy of three exposure/postprocessing schemes using multiple–pinhole cameras. (auth)

26872 PERSONAL DOSIMETRY OF SHORT-LIVED RADON DAUGHTER PRODUCTS. Singer, J.; Trousil, J. (Inst. for Research, Production, and Use of Radioisotopes, Prague). Radioisotopy; 15: No. 3, 375-385(1974). (In Czech.).

On the basis of a literature survey the advantages and disadvantages of three methods (film, thermoluminescent, and solid state track detector) suitable for personal dosimetry of short-lived radon daughters are discussed. Results are presented which were obtained with the solid-state track detector method. A dosemeter, consisting of a housing accommodating a device for controlled aspiration of the mine atmosphere and of the proper detector —cellulose triacetate (Triafol) or polycarbonate (Macrofol) —is described. The conditions of chemical processing (etching) were established for these detectors, which were irradiated with alpha particles from an Am-standard source in which the alpha emission and the energy spectrum were measured in a defined geometry. Some characteristics are reported, e.g., the detection efficiency for alpha particles for track counting with a microscope or with a spark counter at optimum etching conditions and detector adjustment for reduced background effect. (auth)

26873 DETERMINATION OF PLANAR DISTRIBUTION OF LOW-ENERGY BETA NUCLIDES AND/OR OTHER RADIONUCLIDES IN TRACER APPLICATIONS IN BIOLOGICAL, BIOCHEMICAL, AND CHEMICAL EXPERIMENTAL SYSTEMS. Tykva, R. Czech Patent 147,198. 24 Mar 1972. 7p. (In Czech).

The sample is inserted in the measuring chamber in which a radiation detector, such as a semiconductor detector is placed, while a driving system causes a movement of the sample relative to the detector to facilitate the scanning of the sample by the detector. The detector output pulses are fed to a pulse processing device evaluating graphically and/or numerically the pulse rate. The driving device and the pulse evaluation is controlled by a pre-set program determining the direction and the length of a step and the scanning velocity. (INIS)

26874 A DATA SORTING AND PROCESSING SYSTEM FOR PHOTONEUTRON RESEARCH. Tourwe, H.; Uyttenhove, J.; van de Vijver, R. (Ghent Rijksuniversiteit (Belgium). Natuurkundig Lab.). Nucl. Instrum. Methods; 118: No. 1, 279-284(1 Jun 1974).

A low-cost, high-efficiency analog-digital electronic system for photoneutron research at the electron linac is described. During the measuring interval, following the machine burst, the information from the 36 BF_3 tubes of the neutron detector is stored parellelly; serial read-out takes place between successive measuring periods. The device was designed for use in (γ,xn) experiments with bremsstrahlung or with monochromatic gamma radiation. (auth)

26875 LONG-TIME BEHAVIOUR OF Si(Li) DETECTORS. Slapa, M. (Institute of Nuclear Research, Warsaw (Poland)). Nucl. Instrum. Methods; 118: No. 1, 237-246(1 Jun 1974).

The long-time behavior of silicon lithium-drifted detectors was studied in the course of storage at 60°C with and without a bias voltage. Some observations on the behavior of these detectors stored at room temperature for periods between one half and two years were also made. It has been found that the observed changes of detector parameters are due primarily to migration of lithium ions in silicon. (auth)

26876 AUTOMATIC GAIN CONTROL CIRCUIT FOR SCINTILLATION PROBE WITH PLASTIC SCINTILLATOR. Macha, B. (Institute of Nuclear Research, Warsaw (Poland)). Nucl. Instrum. Methods; 118: No. 1, 231-235(1 Jun 1974).

An automatic gain control circuit is described, allowing stabilization of a radiation spectrum exhibiting no photopeak. Its operating principle is based on comparison of the count rate above two discrimination levels. One of them is usually selected near the upper end of the radiation spectrum where the relative slope of the integral curve is high, the other one where the relative slope is low. The AGC described can also be used for stabilization of a radiation spectrum exhibiting a photopeak. (auth)

26877 DETECTION OF SOFT X-RAYS WITH A XENON PROPORTIONAL SCINTILLATION COUNTER. Policarpo, A. J. P. L.; Alves, M. A. F.; Salete, M.; Leite, S. C. P.; dos Santos, M. C. M. (Coimbra Univ. (Portugal)). Nucl. Instrum. Methods; 118: No. 1, 221-226(1 Jun 1974).

Soft x-rays were detected with a xenon proportional scintillation counter; for example, full widths at half maximum of 100 eV and 140 eV were obtained for the carbon and oxygen x-rays, respectively. Window sizes up to 100 mm^2 were used. The measured value of the Fano factor, 0.170 ± 0.007, implies that the ultimate relative standard deviation of the pulses is 0.06 $E^{-\frac{1}{2}}$ (E in keV) to be compared to the experimental determination 0.087 $E^{-\frac{1}{2}}$. (auth)

26878 A PORTABLE FOUR-DECADE LOGARITHMIC G. M. SURVEY METER. Fraser, H. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nucl. Instrum. Methods; 118: No. 1, 263-267(1 Jun 1974).

The design of a portable battery-powered survey meter with a four-decade logarithmic response is discussed and a circuit is given which covers the range 0.1 mR/h to 1 R/h without range switching. A log-diode circuit is used which results in low power consumption. The circuit is designed to be free of any "turn-back" effects at high dose rates. Drift and errors in indicated count rates are less than 0.1 decade over the range 0.50°C ambient temperature and over the range of battery voltage permitted during its life. The response time ranges from 5s to 1s and is determined by a fixed 1s time constant in addition to a log-diode-circuit time constant of $\frac{1}{2}$ (rate in mR/h)$^{-1}$ s. The statistical rms deviation reduces from 18% at 1 mR/h to 0.8½ at 1 R/h. The size of the prototype instrument is 14 × 9 × 4 cm^3 and it weighs 0.5kg. A mercury battery is used with a life of 200h (5 mA) for levels of radiation up to 100 mR/h and 75h (13.5 mA) at 1 R/h. The survey meter is well suited to production by integrated-circuit techniques which would effectively eliminate drift problems more economically than the discrete component circuit presented here. The design conforms to the recommendations of the International Electrotechnical Commission for a health-physics instrument Class 2. (auth)

26879 EFFECT OF THE ELECTRON-MOMENTUM DISTRIBUTION ON THE SHAPE OF THE COMPTON EDGE OF Si(Li) DETECTORS. Felsteiner, J.; Kahane, S.; Rosner, B. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). Nucl. Instrum. Methods; 118: No. 1, 253-255(1 Jun 1974).

The effect of the momentum distribution of electrons in silicon on the shape of the Compton edge of Si(Li) detectors is investigated. A fairly good agreement is found between the observed shape of the Compton edge and the calculations using the non-relativistic Compton differential cross section. The possibility of calibration of high-resolution solid-state detectors by means of the Compton edge is discussed. Such calibrations may be useful in cases where the photoelectric cross-section is very small. (auth)

26880 BORON COMPOUNDS FOR THERMAL-NEUTRON DETECTION. Ananthanarayanan, K. P.; Gielisse, P. J. (Rhode Island Univ., Kingston (USA)); Choudry, A. (Rhode Island Univ., Kingston (USA). Dept. of Physics). Nucl. Instrum. Methods; 118: No. 1, 45-48(1 Jun 1974).

Pressed pellets of hexagonal boron nitride (BN), boron oxide (B_2O_3), boron phosphide (BP), as well as electrophoretically deposited BN have been evaluated as detectors for thermal neutrons. The current-versus-voltage characteristic was studied for each of these materials before and during irradiation with a neutron flux of about 10^8 n/cm^2s. The dark current was lowest in the B_2O_3 pellets and highest in the BP pellets with that of BN lying intermediate, as might be expected from their forbidden gaps. The differences observed during irradiation in the current values for the three boron compounds have been explained as being due to the "boron to anion" atomic-weight ratio being different in them. (auth)

26881 ANODE SURFACE AREA AND AGEING OF SELF-QUENCHING (ARGON-METHYLAL) GM COUNTERS. Peeva, A.; Karatoteva, T. (Sofia Univ. (Bulgaria)). Nucl. Instrum. Methods; 118: No. 1, 49-50(1 Jun 1974).

The effect of ageing is studied for self-quenching GM counters of differently combined electrode diameters. The results obtained show that: 1) the basic factor contributing to the ageing of a counter is the change of the anode surface area; 2) this change appears in the discharge zone and is developed in three consecutive stages: (a) appearance of a fine powder, (b) appearance of spikes and flakes, and (c) formation of granules situated almost evenly along the anode length. 3) The anode surface could be brought to a state corresponding to a given stage, either through a definite number of recorded pulses, or by a certain intensity of the field, i.e., the change is dependent on the momentum of the products attacking the anode. The investigations are carried out with the purpose of confirming the role of the anode found previously—this role is basic for the operating of the counter. (auth)

26882 IDENTIFICATION OF HEAVY IONS IN AgCl MONOCRYSTALS BY MEANS OF MULTIPLE COULOMB SCATTERING. Cincheza, I. M.; Friedlaender, E. M.; Haseganu, D. G. (Institutul de Fizica Atomica, Bucharest (Romania)). Nucl. Instrum. Methods; 118: No. 1, 55-59(1 Jun 1974).

The scattering constant of AgCl monocrystals was estimated by comparing the multiple Coulomb scattering of stopping ^{16}O ions as a function of residual range in an AgCl monocrystal and in Ilford G5 nuclear emulsion. The ratio of scattering constants for the two media was found to be 1.255 ± 0.038, as compared to the theoretical prediction of 1.273. Absence of sizeable distortion in the monocrystal was checked by measurements on fast ^{16}O ion tracks. The reading noise level on the AgCl tracks was found to be at most equal to that in nuclear emulsion. From the observed dispersions it is estimated that a track length of 8mm in the monocrystal should be sufficient to estimate the ion charge within one unit. (auth)

26883 QUENCHING ANALYSIS OF LIQUID SCINTILLATION. Takiue, M. (Tokyo Metropolitan Isotope Research Center (Japan)); Ishikawa, H. (Japan Atomic Energy Research Inst., Tokyo. Radioisotope School). Nucl. Instrum. Methods; 118: No. 1, 51-54(1 Jun 1974).

Liquid scintillation quenching has been measured, separating it into chemical and color quenchings. A measuring geometry which consists of an isolated system and a peaked spectrum of internal conversion electrons emitted from ^{113}Sn-^{113m}In was utilized for the quenching measurement. Values of the chemical quenching with respect to various quenchers can be found, which would lead to a clue to account for chemical quenching. (auth)

26884 DETECTION OF PROTON-INDUCED BORON X-RAYS WITH A Si(Li) DETECTOR. Musket, R. G. (Sandia Labs., Livermore, Calif. (USA)). Nucl. Instrum. Methods; 117: No. 2, 385-389(15 May 1974).

Detection of boron K_α x-rays by a windowless Si(Li) detector has been demonstrated. The B K_α x-rays were generated by bombarding a polished boron target with 350 keV protons. Determination of the detection efficiencies for proton-induced C K_α and O K_α x-rays permitted evaluation of the effective gold-layer and dead-layer thickness for the detector. These layer thicknesses and tabulated mass absorption coefficients were employed to calculate the energy dependence of the detector efficiency. Finally, a linear relationship between x-ray energy E and detected pulse-height was found for $183 \text{ eV} \leq E \leq 1486 \text{ eV}$. (auth)

26885 RESTORATION OF HUM-CONTAMINATED CORRELATION FUNCTIONS. Mikulski, A. T.; Seifritz, W. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Kerntechnik). Nucl. Instrum. Methods; 117: No. 2, 405-408(15 May 1974).

Two calculation procedures for restoring hum-contaminated correlation functions are presented. The first method is based on a forward-backward Fourier transformation which removes hum contributions in the power spectral density function. The second approach is based on a digital filtering technique in the time domain with the help of an algorithm based on a notch-type filter in the frequency domain, whose zeros coincide with frequencies of direct or aliased hum peaks. Both methods are applied to an experimental example, thus demonstrating both the necessity and the usefulness of such techniques in practice. (auth)

26886 SOME FORMULAE FOR A DEAD-TIME-DISTORTED POISSON PROCESS. Mueller, J. W. (Bureau International des Poids et Mesures, 92 - Sevres (France)). Nucl. Instrum. Methods; 117: No. 2, 401-404(15 May 1974).

For a Poisson process distorted by a non-extended dead time, a complete set of exact formulae is presented for the probability, the expectation and the variance of the number of events in a given measuring time. (auth)

26887 AN EFFICIENT READ-OUT SYSTEM FOR MULTIWIRE PROPORTIONAL COUNTER HODOSCOPES. Austin, R. W.; Selig, W. J. (National Aeronautics and Space Administration, Huntsville, Ala. (USA). George C. Marshall Space Flight Center). Nucl. Instrum. Methods; 117: No. 2, 429-434(15 May 1974).

An efficient scanning method for readout of a multiwire proportional counter hodoscope is presented. This method which utilizes the grouping of wires in the hodoscope readout system offers distinct advantages in speed and simplicity over systems employing long shift registers. Power consumption and cost can be minimized with this method because of slower clock speeds and a low parts count. This system has been constructed and used on a hodoscope for cosmic-ray trajectory measurements and a lower-power version has been designed for satellite applications. (auth)

26888 DATA SIMULATION TECHNIQUES FOR REACTIONS OF THE FORM X (a,bc) Y. Fritts, M. J.; Parker, P. D. (Yale Univ., New Haven, Conn. (USA). Nuclear Structure Lab.). Nucl. Instrum. Methods; 117: No. 2, 415-427(15 May 1974).

A data simulation technique is presented for use in the analysis of multiparticle final states when two of the particles are detected in coincidence. Experimental effects which broaden the energy and angular resolution are folded into the theoretical predictions to allow direct comparisons with the experimental data. (auth)

26889 THE SOLID ANGLE SUBTENDED BY A SOLID, RIGHT, CIRCULAR CYLINDER AS SEEN FROM A POINT IN SPACE. Green, M. V.; Aamodt, R. L.; Johnston, G. S. (National Institutes of Health, Bethesda, Md. (USA)). Nucl. Instrum. Methods; 117: No. 2, 409-412(15 May 1974).

A Monte-Carlo technique was utilized to calculate the solid angle subtended by a solid, right, circular cylinder as seen from a point in space for two height-to-radius ratios of the cylinder, two-to-one and one-to-one. The calculation was made for source-point distances out to twelve cylinder radii from the cylinder center and for angular displacements of the source point up to ninety degrees from the cylinder axis. (auth)

26890 AN AUTOMATIC COUNTING SYSTEM FOR ACTIVATION ANALYSIS. Sens, J. C.; Pfleger, J. C.; Pape, A.; Armbruster, R. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires). Nucl. Instrum. Methods; 117: No. 2, 455-458(15 May 1974).

The turntable, the command circuits for controlling its motion, and a data reduction program, which have been assembled to automate the routine counting of radioactive samples, are described. (auth)

26891 RECOIL-DISTANCE DATA ANALYSIS FOR INCOMPLETELY RESOLVED STOPPED AND IN-FLIGHT COMPONENTS. Engelstein, P.; Forterre, M.; Schulz, N.; Vivien, J. P. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France)). Nucl. Instrum. Methods; 117: No. 2, 413-414(15 May 1974).

A method for analyzing data in recoil-distance lifetime measurements is described. It suits especially cases where the stopped and in-flight components are incompletely resolved. An example of the application of the method is presented. (auth)

26892 THE INTERACTION OF NEUTRONS WITH FLUORINE IN NE-226. Bartle, C. M. (Wisconsin Univ., Madison (USA)). Nucl. Instrum. Methods; 117: No. 2, 569-572(15 May 1974).

The neutron-induced reactions on "hydrogen-free" NE-226 have been studied between 6 and 11 MeV. At these energies pulse-shape discrimination between charged-particle reaction products and electrons is possible. The $^{19}F(n,p)^{19}O(g.s. + 1)$ reaction is identified through a comparison of the proton response curve for NE-226 and the corresponding curve for NE-231 (having a hexafluorobenzene and benzene solvent material, respectively). From the (n,p) cross sections obtained from the data it is possible to measure neutron flux in a mixed radiation field. (auth)

26893 FINITE-SIZE EFFECTS IN NEUTRON DETECTORS. Watson, J. W.; Graves, R. G. (Texas Agricultural and Mechanical Univ., College Station (USA). Cyclotron Inst.). Nucl. Instrum. Methods; 117: No. 2, 541-549(15 May 1974).

Geometry-dependent effects in scintillator neutron detectors are discussed. Of particular interest are "edge effects" where energetic charged recoils leave the scintillator volume. A computer program has been written to calculate these edge effects in recoil pulse-height spectra. Calculations are presented for several detector geometries and comparisons with experimental recoil pulse-height spectra are made. Good agreement is found between calculation and experiment. (auth)

26894 INVESTIGATIONS ON METAL CONVERTERS FOR GAMMA-RAY DETECTION AND MAPPING. Shimoni, U.; Sheinfux, B.; Seidman, A.; Grinberg, J.; Avrahami, Z. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). Nucl. Instrum. Methods; 117: No. 2, 599-603(15 May 1974).

The efficiency of metal converters is investigated. A simple method for the evaluation of conversion efficiency is given. The optimal thickness of converter plate was found experimentally. The design of two types of high-energy converters is described and an application to X- and γ-ray detectors is suggested. (auth)

26895 AUTOMATIC GAIN CONTROL SYSTEM FOR SCINTILLATION DETECTORS. Haouat, G.; Gimat, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 – Montrouge (France)). Nucl. Instrum. Methods; 117: No. 2, 611-612(15 May 1974). (In French).

A new gain-control system for scintillation detectors is presented. It consists of a photodiode coupled to a resistor having a negative temperature coefficient. (auth)

26896 THE GSFC EUV AND X-RAY SPECTROHELIOGRAPH ON OSO-7. Underwood, J. H. (Aerospace Corp., Los Angeles, Calif. (USA)); Neupert, W. M. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Solar Phys.; 35: No. 2, 241-258(Apr 1974).

The Goddard Space Flight Center instrument carried on the pointed section of the OSO-7 satellite is described. This instrument contains an extreme ultraviolet spectroheliograph using glancing incidence optics of Wolter's Type II to focus the Sun's light on the entrance slit of a concave grating spectrometer, an auxiliary Hα system, two x-ray spectroheliographs using mechanical collimators for spatial resolution and Ross filters to isolate spectral bands of interest, and a flare polarimeter operating in the 15–40 keV X-ray region. These subsystems may be operated in a number of modes which, when combined with the spacecraft modes, give the instrument great flexibility for making solar observations. Representative results from each of the subsystems are presented. (14 figures, 2 tables) (auth)

Radiation Dosimeters

Refer also to abstracts 26474 and 28577.

26897 (CONF-730907-P1, pp 100-105) ULTRAVIOLET RADIATION DOSIMETRY UTILIZING THERMOLUMINESCENCE. Dhar, A.; DeWerd, L. A.; Stoebe, T. G. (Univ. of Washington, Seattle). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

An integrating dosimeter to detect ultraviolet radiation has been developed using the process of "direct" ultraviolet stimulation. This process yields a thermoluminescent signal after an exposure to ultraviolet radiation without prior exposure to ionizing radiation. Various crystals were compared for sensitivity to ultraviolet radiation. The spectral sensitivity, linearity with exposure and long range stability of the stored energy were investigated for MgO crystals which had the most sensitive response. The results of these tests indicate that a sensitive ultraviolet dosimeter can be developed using this phenomenon. (auth)

26898 (CONF-730907-P1, pp 394-399) LONG-TERM USE OF VARIOUS SOLID-STATE DOSIMETERS FOR ENVIRONMENTAL MONITORING OF NUCLEAR PLANTS: EXPERIENCE AND RESULTS. Burgkhardt, B.; Piesch, E.; Winter, M. (Karlsruhe Nuclear Research Center, Ger.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Solid-state dosimeters placed in the open air in the vicinity of the Karlsruhe Nuclear Research Center have been used to assess the natural radiation background and influences from radiation sources. The exposure periods of phosphate glass, LiF, and CaF_2 dosimeters ranged from six months down to four days, depending on different monitoring problems. (auth)

26899 (CONF-730907-P1, pp 515-527) PROGRESS IN PERSONNEL NEUTRON DOSIMETRY. Hankins, D. E. (Los Alamos Scientific Lab., NM). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Progress in personnel neutron dosimetry is reviewed. A survey of the various albedo-neutron dosimetry systems that have been developed shows the advantages and disadvantages of each of the systems. The energy dependence of the albedo-neutron dosimeters is rather poor, and the effect of this on their accuracy and usefulness is discussed. Fission-fragment damage to polycarbonates has been studied extensively, with most investigators using the spark-counter technique for evaluation. A survey is made of the systems currently in use, and the problems associated with their use are discussed, including sensitivity, evaluation time, and exposure of the wearer to the fissionable material. Other systems under study but not yet in practical application are discussed briefly and include thermally stimulated exoelectron emission (TSEE), direct response of thermoluminescent-dosimeter (TLD) materials to fast neutrons, and the response of TLD materials to recoil protons. (auth)

26900 (CONF-730907-P1, pp 550-555) NEW TECHNIQUE FOR IMPROVED TRACK RECOGNITION IN NUCLEAR EMULSION FILM DOSIMETRY USING SOFT X-RAYS. Balasubrahmanyam, V.; Szegedi, L. (Radiation Protection Bureau, Ottawa). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The property of grain size and granularity variation with x and gamma radiation of differing energy is used to improve the recognition of proton tracks in nuclear emusions. Suitable x-ray qualities and exposure levels were investigated for this purpose. It was found that by using x-rays of 10 kV and a pre-exposure of 30 mR, the sensitivity of the neutron film could be increased by 15%. This study is based on exposures made using a Pu : Be neutron source. This enhancement relieves considerable eye strain of the scanner and in addition, one is able to pick out easily shorter tracks in neutron monitoring films. (auth)

26901 (CONF-730907-P1, pp 556-562) THERMOLUMINESCENT PERSONAL DOSEMETER COMPATIBLE WITH AUTOMATIC PROCESSING AND THE CENTRAL RECORDING OF DOSE HISTORIES. Shaw, K. B.; Marshall, T. O.; Casbolt, P. N. (National Radiological Protection Board, Harwell, Eng.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Factors influencing the choice of a thermoluminescent dosemeter are discussed. The dosemeter must be economic to produce, process and dispatch, i.e., it must be convenient to the user and provide reliable dose information. The dosemeter must be compatible with automatic processing and the central recording of dose histories. A prototype dosemeter was designed based on ^{7}LiF. The dosemeter is required to measure separately low-penetrating and penetrating radiation doses and a filter system has been designed for this purpose. The low-penetrating and penetrating dose concepts are discussed together with the problems associated with achieving this requirement. The energy response data influencing the choice of filter system are given. (auth)

26902 (CONF-730907-P1, pp 563-567) UNIVERSAL AUTOMATIC TLD-READER FOR LARGE-SCALE RADIATION DOSIMETRY. Julius, H. W.; Verhoef, C. W.; Busscher, F. (Organization for Health Research TNO, Arnhem, Netherlands). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A universal automatic TLD-reader has been developed that can accept most of the present and probably many future types of solid TL-detectors. Perfect temperature contact, low background signal, high sensitivity, short cycle-times (about 18 sec, sample changing included) and good reproducibility are secured by heating the detectors with jets of hot nitrogen gas. A special manipulating device enables the reader to accept TLD's as offered by any sample changer (e.g., rotating disc or conveyor belt), making the instrument applicable in large scale personnel monitoring, environmental control, radiation therapy, etc. The automatic selection of dosimeters with uniform sensitivity is one of the features of this instrument. (auth)

26903 (CONF-730907-P1, pp 568-571) ANNEALING TLD's EXPOSED TO HIGH LEVELS OF NEUTRON AND GAMMA RADIATION. Endres, G. W. R.; Eichner, F. N.; Nichols, L. L. (Battelle Pacific Northwest Lab., Richland, WA). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Experimental programs involving radiation dose measurements at high levels (greater than 100 rads) have led to problems in reuse of thermoluminescent dosimeters (TDLs). Accepted procedures for annealing the TLDs in many cases do not entirely eliminate all of the stored energy trapped in the crystal lattice during the high level exposures. Several procedures for annealing ^{7}LiF, ^{6}LiF and CaF_2:Dy were studied to determine which one would best restore the TLDs to the original background readings and sensitivity. Results are given in numerical and graphical form to show that many of the dosimeters are restored to usefulness after long-term annealing in a nitrogen atmosphere. For ^{7}LiF in a period of 16 hours at 400°C in a nitrogen fed furnace plus 2 hours at 100°C in air satisfactorily anneals dosimeters exposed to as much as 3500 rads from radium and ^{252}Cf radiation sources. These dosimeters have the same sensitivity to a 500 mR calibration exposure as unused dosimeters from the same batch of LiF. All dosimeters used were in the form of $\frac{1}{8}'' \times \frac{1}{8}'' \times 0.035''$ blocks, and all annealing was accomplished in vicor glass dishes. The dosimeters were placed through the standard anneal of 1 hour at 400°C plus 2 hours at 100°C to determine the completeness of the special long-term anneal. (auth)

26904 (CONF-730907-P1, pp 572-577) TLD PERSONNEL MONITORING SYSTEM WITH AUTOMATIC PROCESSING. Boetter-Jensen, L.; Christensen, P.; Majborn, B. (Danish Atomic Energy Commission Research Establishment, Roskilde). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The development work carried out at Risø on a TLD personnel monitoring system with automatic processing is summarized. The system is based on identification coded personnel badges and includes an automatic TLD reader. Experimental results are presented and the interpretation of monitoring data is discussed. (auth)

26905 (CONF-730907-P1, pp 578-583) SOME PRACTICAL APPLICATIONS OF SINTERED BeO as TL DOSIMETER. Benincasa, G.; Ceravolo, L.; Scarpa, G. (CNEN, Rome). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International radiation protection association.

Some new experiments have been carried out in order to get further information about the possible application of the thermoluminescence of ceramic undoped beryllium oxide to some specific practical fields, such as health physics measurements and dose intercomparisons. The results of these experiments are described and a conclusion is drawn that ceramic BeO, even of commercial electronic grade, can be used with success and advantage in the specific dosimetric fields referred to above, in addition to its typical use in mixed radiation fields of neutrons and gamma rays. (auth)

26906 (CONF-730907-P1, pp 584-588) COMPOUNDS OF TLDs AND HIGH-MELTING ORGANICS FOR FAST NEUTRON PERSONNEL DOSIMETRY. Becker, K.; Tham, T. D.; Haywood, F. F. (Oak Ridge National Lab., TN). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In this feasibility study, a finely powdered, highly sensitive and fading resistant phosphor ($CaSO_4$:Dy) has been hot-pressed into pellets with p-sexiphenyl (melting point ~450°C) as a high-melting and stable hydrogenous radiator. Outgassing of the pellets in a vacuum furnace at 150°C removed residual volatile impurities. The response of detector pairs, consisting of such pellets and of Teflon-embedded phosphors, has been investigated. The sexiphenyl-embedded phosphor is sensitive to uv light. An efficiency of about 50% of the gamma radiation response was observed for recoil protons produced by fission and also for 14 MeV neutrons. The response is a linear function of dose. Desirable follow-up studies are outlined. (auth)

26907 (CONF-730907-P2, pp 889-899) DOSIMETRY OF GALACTIC AND SOLAR RADIATION ON-BOARD THE SUPERSONIC TRANSPORT CONCORDE. Francois, H. (CEN, Fontenay-aux-Roses, France); Delahaye, R. P.; Simon, P.; Portal, G.; Kaiser, H.; Durney, P. Feb 1974. (In French).

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Dosimetry of radiation on-board the French prototype supersonic transport Concorde 001 was performed during the aircraft's test flights from its Toulouse base. The supersonic transport medical subcommittee of the General Secretariat for Civil Aviation directed these radiation measurement activities. Actual dosimetric operations were conducted by different specialized laboratories employing the following systems and techniques: (1) "Passive" integrator dosimetric systems. (a) nuclear emulsions in which each event is individually analyzed, (b) stacks of nuclear emulsions of varying sensitivity which permit obtaining ionizing-particle distribution as a function of their TEL, (c) radiothermoluminescent dosimeters, and (d) fast-neutron dosimeters. (2) Dose-rate recording systems. The authors analyze, compare, and comment upon results obtained. In addition, the dosimetric problems posed by possible solar flares and their effects upon flight plans are discussed. Conclusions are drawn relative to the possible dosimetry techniques to be employed in identifying radiation protection problems on-board the SST. (auth)

26908 (CONF-730907-P2, pp 1440-1445) COMPARISON OF ALBEDO DOSIMETERS AND NUCLEAR TRACK DETECTORS FOR NEUTRON MONITORING. Piesch, E.; Burgkhardt, B. (Karlsruhe Nuclear Research Center, Ger.). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The albedo neutron dosimeters so far used in personal dosimetry provided oversensitive indications of intermediate and thermal neutrons. Therefore, correction factors dependent on the location had to be used to assess the dose equivalent. An albedo dosimeter tested at the Karlsruhe Nuclear Research Center showed promising results in measuring the dose equivalent of fast neutrons. Intercomparison measurements with nuclear track detectors were performed to indicate the dosimeter response, influence of the energy dependence and of the direction of the radiation incidence on the dosimeter reading. (auth)

26909 (CONF-730907-P2, pp 1446-1451) SOME POSSIBILITIES OF USE OF SILICON DETECTORS OF IONIZING RADIATIONS IN INVESTIGATIONS OF RADIATION SHIELDING. Petushkov, A. A.; Manchuk, V. A. Feb 1974. (In Russian).

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The possibility of application of pulse rate measurements for x- and gamma-ray dosimetry with silicon radiation detectors was investigated. It was shown that this mode of operation ensures the sensitivity of 10^{-6} r.min^{-1} for the detectors used in this work, and it is possible to decrease the energy dependence of sensitivity, for use in many radiation protection investigations by increasing the discrimination threshold. The general expression which can be used for rough estimates of sensitivity for these detectors was determined. The background count rate of surface barrier detectors with different sensitive areas from 0.2 to 60 cm^2 in the alpha particle energy interval of 3 to 9 MeV was determined. It is suggested for health physics and radiation protection monitoring of alpha particles and simultaneous spectrometry to use the mosaic probe with large sensitive area (~60 cm^2) which consists of many parallel united detectors one of which could be eliminated for spectrometric measurements. (auth)

26910 (COO-1105-213) FAST NEUTRON DOSIMETRY BY ACTIVATION OF TL PHOSPHORS. Progress Report, July 15, 1973-July 15, 1974. Pearson, D. W.; Moran, P. R. Wisconsin Univ., Madison (USA)). 1974. Contract AT(11-1)-1105. 14p. Dep. NTIS $4.00.

Thermoluminescent phosphors are used as beta dosimeters to measure the dose from the decay of radioactive nuclei produced in the phosphor by fast neutrons via threshold reactions. The following reactions have been used: $^{19}F(m, Zn)^{18}F$, threshold = 12 MeV; $^{24}Mg(n,p)^{24}Na$, threshold = 7 MeV; $^{64}Zn(n,p)^{64}Cu$, threshold = 4 MeV; $^{32}S(n,p)^{32}P$, threshold = 2.5 MeV; together with activation at thermal thresholds of ^{164}Dy, ^{55}Mn, and ^{68}Zn. These nuclei were incorporated in the following phosphors: LiF, CaF_2:Dy, CaF_2:Mn, $CaSO_4$:Dy, Mg_2SiO_4:Tb, and ZnO:Tm. At 14 MeV, neutron fluences as low as 10^7 n/cm^2 can be detected. When the TL is read with photon counting techniques, one or more photons are detected for each beta disintegration so that the fundamental limits are the number of activations and the intensity of background sources, and not the TL sensitivity (LiF is an exception). Practical limitations are discussed. (auth)

26911 (COO-1105-214) TL IN LiF(TLD-100) AND $CaSO_4$:Dy. Progress Report, July 15, 1973–July 15, 1974. Mayhugh, M. R. (Wisconsin Univ., Madison (USA)). [nd]. Contract AT(11-1)-1105. 7p. Dep. NTIS $4.00.

The following conclusions from a study are presented: (A) pre-existing radiation damage (after 2 MR) does not alter the supra-linearity and saturation of LiF(TLD-100); (B) high-temperature TL in LiF(TLD-100) can be eliminated by optical bleaching at 280°C without appreciably altering increased sensitivity in peak 5 (~200°C). This result is a counter-example to the suggestion that the high-temperature TL peaks accompany sensitization, and (C) photostimulated TL in Dy activated calcium sulfate appears to depend on the energy of the enabling (previous) exposure in the way that the direct TL does, while in LiF(TLD-100) these energy dependences for direct and photostimulated TL are different from one another. (auth)

26912 (COO-1105-215) SUMMARY OF PROGRESS IN SOLID STATE DOSIMETRY. Progress Report, July 15, 1973–July 15, 1974. Moran, P. R. (Wisconsin Univ., Madison (USA)). 1974. Contract AT(11-1)-1105. 6p. Dep. NTIS $4.00.

In the past contract year, research progress was documented in USAEC Technical Reports COO-1105-203 through COO-1105-214. This report summary outlines the chief features of the work discussed in those separate reports, beginning with more recent projects and including on-going projects initiated at earlier dates. A final section gives a summary of non-technical information relevant to the work pursued under Contract AT-(11-1)-1105. (auth)

26913 DOSIMETRY OF THE RADIATION FROM CALIFORNIUM-252. Greene, D.; Major, D. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Phys. Med. Biol.; 19: No. 4, 448-459(Jul 1974).

In using the two chamber method to separate components of neutron dose and γ-ray dose in the mixed beam from californium-252, difficulties arose in determining the chamber sensitivities to neutrons from their calibration with a standard cobalt-60 γ-ray field. This was because in the neutron field neither chamber could be regarded as a Bragg-Gray cavity. Conversion factors were calculated for two chambers of the same geometry, one made with tissue-equivalent walls and gas filling and the other made with carbon walls and used either with air or with carbon dioxide gas filling. The expected accuracies of dose measurement have been found to be ±6% for total dose, ±9% for the neutron component and ±7% for the γ-ray component. (auth)

26914 APPLICATION OF THERMALLY STIMULATED CURRENTS IN SOME PLASTICS AND GLASSES TO RADIATION DOSIMETRY. Bowlt, C.; Waggett, D. J. (Royal Free Hospital, London). Phys. Med. Biol.; 19: No. 4, 534-540(Jul 1974).

The high temperature thermally stimulated currents (TSC) induced by ionizing radiation in four plastics (Kapton, Melinex, Nylon "66", PTFE) and two glasses (Spectrosil, As_2S_3) were investigated. Only PTFE and Spectrosil showed TSCS larger than their dark currents. The usefulness of PTFE for TSC dosimetry appears to be limited by fading. Spectrosil with OH impurity showed large TSC response to radiation with exposures of 50 R being easily measurable. The observed linear increase in response with dose up to at least 1.5 kR, the small variation in response with radiation energy, and the lack of fading make Spectrosil a promising material for TSC dosimetry. (auth)

26915 AN EXTRAPOLATION CHAMBER FOR THE CALIBRATION OF BETA–RAY APPLICATORS. Payne, W.H.; Waggener, R.G. (Department of Radiology, The University of Texas Health Science Center at San Antonio, San Antonio, Texas 78284). Med. Phys. 1: No. 3, 165-166 (1 May 1974).

A simple, easily constructed extrapolation chamber is described for the calibration of β–ray applicators. (AIP)

26916 SINGLE CRYSTAL SAPPHIRE: A THERMALLY STIMULATED CONDUCTANCE (TSC) RADIATION DOSIMETER. Fullerton, G.D.; Moran, P.R. (Departments of Physics and Radiology, University of Wisconsin, Madison, Wisconsin 53706). Med. Phys. 1: No. 3, 161-162 (1 May 1974).

We show measurement of thermally stimulated conduction (TSC) in high–purity sapphire to be a potentially useful technique for ionizing radiation dosimetry. The TSC thermogram, conduction current vs temperature or time, has current peaks that are proportional in height to irradiation. The peak height response to x rays is: (1) linear with doses from 10 mR to 100 R (^{60}Co energy); (2) useful from 10 mR to 10^4 R (^{60}Co energy); (3) reusable with no additional treatment for exposures less than 1000 R; (4) exposure rate independent from at least 0.12 mR/sec to 3.2 R/sec; (5) stable; and (6) reasonably similar to tissue response as a function of energy. The stability of response, simplicity of instrumentation requirements, and dependable supply of materials at competitive price with other dosimetry systems favor application of this technique. (auth)

26917 INTERNATIONAL COMPARISON OF MEASUREMENT PRECISION OF PERSONAL EXPOSURES TO IONIZING RADIATION. Hecker, O.; Kraus, W.; Musialowicz, T.; Referowski, Z.; Rothe, W.; Singer, J.; Trousil, J.; Wysopolski, J. Radioisotopy; 15: No. 3, 401-413(1974). (In Czech).

An international comparison of measurement precision of exposures to photon radiation using the method of film dosimetry is described. In total, 738 exposures to mixed photon radiation in the range from 50 mR to 20 R were compared. The energy range was from 15 keV to 1.25 MeV. The results of evaluation of film dosemeter exposures have shown that the participating laboratories evaluate reliably the gamma radiation (more than 70% of measurements had an error smaller than ±10% and more than 90% less than ±30%), high x-exposures are slightly overestimated and low exposures to gamma + x mixtures are somewhat underestimated. More than 90% of all x-exposures and more than 70% of all mixed exposures, however, lie within the limit of ±30%. As evident from the results, the Czechoslovak laboratory measured more than 90% of all exposures with an error not greater than ±30%, the respective percentage in the laboratory of the GDR was 80% and in the PPR 70% of all exposures. The performed measurements confirmed the feasibility of mutual comparison, eventually of common evaluation of the annual statistics of professional exposures as well as the opinion of experts of participating countries that a replacement of the film dosimetry method by another method is not necessary from the standpoint of measurement precision. (auth)

26918 USE OF A SILICON DIODE IN PERSONAL NEUTRON DOSIMETRY. Frank, H.; Seda, J.; Trousil, J.; Rusnok, J. (Inst. for Research, Production, and Use of Radioisotopes, Prague). Radioisotopy; 15: No. 3, 387-400(1974). (In Czech).

The results of research on a new fast neutron dosemeter with a silicon diode are summarized. The fundamentals of the physics of the silicon diode for fast neutron dosimetry are presented, together with results reported in world literature. Also, the basic dosimetric properties of a homemade silicon diode, i.e., the dependence of potential changes as a function of fast neutron fluence (14.7 MeV), gamma sensitivity, and fading are presented. The values are compared with those of the Swedish AEG silicon diode. (auth)

26919 THERMOLUMINESCENT DOSEMETER IN THE NATIONAL PERSONAL DOSIMETRY SERVICE. Fejtek, J.; Trousil, J. (Inst. for Research, Production, and Use of Radioisotopes, Prague). Radioisotopy; 15: No. 3, 357-366(1974). (In Czech).

The basic dosimetric properties of the radiothermoluminescent alumino-phosphate glasses produced in Czechoslovakia are described. A brief description is given of the Teledyne Isotopes reading equipment which was used for measurements and of the measurement method. Results are presented of the exposure dependence of the response measurements, and fading and energy dependence measurements are reported. Finally, the results of comparative measurements of the dosimetric properties of the local RTL alumino-phosphate glass and the US made LiF are presented. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 26412, 26786, and 28504.

26920 (AED-CONF-74-157-008) A SYSTEM ANALYSIS OF GAMMA-RAY SPECTROMETRY AND A REALISATION OF ON-LINE EVALUATION FOR ENVIRONMENTAL SAMPLE CONTROL OR OTHER PURPOSES. Winiger, P.; Halter, J.; Huber, O. (Fribourg Univ. (Switzerland). Inst. de Physique). 1974. 16p. INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

3 figs.; 2 tabs.; 4 refs.; with app. With abstract in English and French.

A reliable on-line analysis system should be as sensitive as possible, save as much time as possible, and the costs of the system should be competitive to the price of a "comparable" hardware analyzer. This implies a shielded Ge(Li)-detector of good resolution and efficiency, a computer-controlled multichannel analyzer of modest size and small peripheral equipment, a corresponding standard software for nuclear spectrometry, input and output routines and a floating point arithmetic. Accurate catalogs of gamma transitions and parametrized detection efficiency curves for as many geometric sample configurations as needed are basic to any evaluation system. A detailed task analysis of gamma-ray spectra evaluation was made and is summarized. Applications to environmental samples are presented. (auth)

26921 (CONF-730907-P2, pp 1464-1469) NEW TECHNIQUE IN ENVIRONMENTAL NEUTRON SPECTROSCOPY. Awschalom, M.; Coulson, L. (National Accelerator Lab., Batavia, IL). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A new phoswich has been developed that permits the measurement of the environmental neutron spectrum using Bonner spheres. The new phoswich consists of an 8 mm diameter, 8 mm long ^{6}LiI (Eu) crystal surrounded by plastic scintillator. The use of the fast signals from the plastic scintillator in anticoincidence with the slow signals from the ^{6}LiI (Eu) gives a nearly background free ^{6}Li(n,α)^{3}He peak. Thus, the signal to noise ratio in the vicinity of the peak is very high (20 to 35 to 1). An adequate number of counts is obtainable in one day for most of the spheres. (auth)

26922 (ITEF-33) GAMMA-SPECTROMETER WITH THE Ge(Li) SEMICONDUCTOR DETECTOR FOR EXPERIMENTS ON THE PROTON ACCELERATOR. Kirpichnikov, I. V.; Kuznetsov, V. A.; Nikiforov, N. A.; Starostin, A. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 22p. (In Russian). INIS.

The characteristics and a block diagram of the γ spectrometer with Ge(Li) semiconductor detectors, developed for use in experiments on the excitation of nuclei by high-energy protons at the proton accelerator, are reported. The characteristics of the electronic circuits, connected with the specific work at the accelerator, are briefly described. The spectrometer and auxiliary equipment made it possible to carry out extended exposures (~5 days). The energy resolution of the spectrometer is ~10 keV for proton energies of 5 to 7 MeV under conditions of repeated overloading of the spectrometric channels. (tr-auth)

26923 (NP-20073) ON-LINE STABILITY MONITOR FOR MOESSBAUER SPECTROMETERS. Gangas, N. H. J.; Prelorendjo, L. A. A. (Ioannina Univ. (Greece). Dept. of Physics). [nd]. 11p. Dep. NTIS (US Sales Only) $4.00.

The principle of operation and the practical features of a simple electronic circuit which permits the on-line monitoring of the performance of Moessbauer spectrometers during the time of measurements are described. The circuit produces in the Moessbauer spectrum two dummy "resonance" lines, whose positions and widths reveal to the experimenter the overall performance of his spectrometer. For a constant acceleration spectrometer the sensitivity of the circuit is such that a 1% variation of the calibration of the spectrometer produces a visually detectable change in the position of a dummy line. (auth)

26924 PREPARATION OF PLANAR LITHIUM DRIFTED GERMANIUM DETECTORS. Balcarcel, R.; Fernandez, A.; Gallardo, R. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis., Supl. Fis. Apl.; 22: FA59-FA68(1973).

The development of the Ge(Li) diode as a detector and energy spectrometer for gamma rays has made possible new experiments in low energy nuclear physics and refinements in existing ones. The primary advantage of the detector is its energy-resolving capability. Lithium drifted germanium detectors are characterized principally by the way in which the radiation sensitive zone is achieved. When the diffused Li ions are drifted under a reverse bias across the original P-type germanium, large intrinsic regions can be obtained in which there are almost no free charge carriers. This is the suitable zone for the detection of nuclear radiation which liberates charge carriers in a number proportional to its energy. A detailed description is made of a method to prepare the above mentioned detectors. (auth)

26925 PROPORTIONAL COUNTER FOR RECORDING ULTRA-SOFT X RADIATION. Smirnov, V. N.; Seregin, Yu. P. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 48-50(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 52-55(1974).

A flow-type proportional counter was developed which allows x radiation to be recorded in the energy range from 0.1 to 1.5 keV. The resolving power is $\delta/\overline{V} = 12.7\%$ for the characteristic Al-K_{α}. The basic working characteristics of the counter are presented for the recording of K lines of the elements from B to Si, as well as the results of determining its limiting sensitivity. (auth)

26926 INVESTIGATING A RESONANCE SCINTILLATION DETECTOR. Dolenko, A. V.; Egiazarov, B. G.; Raikhman, E. M. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 56-58 (1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 58-60(1974).

A scintillation resonance detector based on $^{119}SnO_2$ is described which is selectively sensitive to γ quanta having an energy of 23.8 keV. The detector records internal-conversion electrons. The advantages of the new detector over conventional nonresonance detectors are demonstrated, and comparative experimental data are presented. (auth)

26927 TRIAXIAL CRYSTAL NEUTRON SPECTROMETER. Shapiro, V. G.; Solov'ev, S. P.; Kukhto, O. L.; Efimovich, O. N. (Scientific-Research Physico-Chemical Inst., Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 29-31(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 36-38(1974).

A triaxial neutron spectrometer is described in which the device for monochromatization of slow neutrons simultaneously rotates the crystal monochromator and shifts it along the neutron-beam axis. This allows the axis of the sample to be made stationary and thus allows a reduction of the mass of the parts of the biological radiation shielding components which were moved during the measurements. Results are presented of measurements of the dispersion relationships on a model sample. The instrument is installed on a VVR-Ts reactor. (auth)

26928 MONOCHROMATOR FOR SLOW NEUTRONS. Kukhto, O. L.; Konstantinov, A. P.; Ruchkov, V. E.; Solov'ev, S. P.; Shapiro, V. G. (Scientific-Research Physico-Chemical Inst., Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 32-33(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 39-40(1974).

A monochromator for slow neutrons is described whose use in neutron spectrometers allows the sample axis to be held motionless. Because of this the mass of the moving biological shielding is reduced, which increases the accuracy with which the sections of the spectrometer are mounted at designed positions. The device provides the possibility of obtaining monochromatic neutrons in the range of wavelengths from 0.9 to 5 A at a fairly high resolving power. (auth)

26929 INCREASING THE STABILITY OF SCINTILLATION SPECTROMETERS. Sabol, I.; Sheda, I. (Prague Polytechnic Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 37-38(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 42-44(1974).

A method is described for automatic gain control of a scintillation spectrometric device by means of a photomultiplier with a control grid. (auth)

26930 SHAPE OF THE EQUIPMENT LINE OF A SEMICONDUCTOR ALPHA SPECTROMETER. Stepanov, E. K.; Stoyanova, S. A.; Tyutikov, N. V. (All-Union Scientific-Research Inst. of Physico-Technical and Radio-Engineering Measurements, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 39-41(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 44-47(1974).

An investigation was made of the shape of the equipment spectra of alpha particles obtained using Soviet silicon surface-barrier detectors of the DKPs and DKPsd types. It is shown that the alpha line may have either a symmetrical or asymmetrical shape, depending on the chosen detector. The causes of the development of the asymmetry of the alpha spectrum were investigated. It was shown that for nonsymmetrical spectra the left and right sides of the alpha lines can be described by Gaussian curves having different parameters. The dependence between the energy resolution and resolving power of the spectrometer is investigated for spectra having various asymmetry coefficients. (auth)

26931 ENERGY CALIBRATION OF HIGH ENERGY ELECTRONS USING A CHERENKOV DETECTOR AND A COMPARISON WITH DIFFERENT METHODS. de Almeida, C. E.; Almond, P. R. (Univ. of Texas, Houston). Phys. Med. Biol.; 19: No. 4, 476-483 (Jul 1974).

One of the basic problems in the use of high energy therapy machines is the precise determination of the primary energy of the electron beam. Some of the techniques commonly used have limitations. For example, in foil activation only a few thresholds exist in the useful energy range and with some machines it is difficult to vary continuously the energy. Uncertainties exist in the range-energy relationship for electron beams and for spectral analysis, expensive equipment is required. A new way of estimating electron beam energy has been developed using Cherenkov radiation generated by relativistic electrons passing through a gas. Two different gases were studied, carbon dioxide and air, which have threshold values of 17.0 and 22 MeV respectively at S.T.P. The detector consisted of a gas filled pipe 120 cm long with a thin brass window at the front and a mirror set at 45° to the beam direction at the far end which reflected the Cherenkov radiation onto the cathode of a photomultiplier tube.

This work was done with a 32 MeV linear accelerator and the energies determined by the Cherenkov method agreed within the limits of experimental error with those from the range energy method. (auth)

26932 ANALYSIS OF MIXED BETA SPECTRA. Dryak, P. (Inst. for Research, Production, and Use of Radioisotopes, Prague). Radioisotopy; 15: No. 3, 415-436(1974). (In Czech).

An apparatus for the measurement of beta spectra was constructed. The apparatus works with two plastic scintillators with a thin sample situated between. The detection is performed in 4π geometry. The apparatus enables measurements of beta spectra with $100 \leq E_{\beta max} \leq 3$ MeV. A Fermi-Curie plot can be constructed from the measured spectra, with deviations from linearity not exceeding a few percent in dependence from the shape and energy, with the exception of the region about $E_{\beta max}$. The method is suitable for identification and quantitative determination of impurities in pure beta emitters. In the case of ^{90}Y content in ^{147}Pm it is possible to determine ^{90}Y in quantities above 0.1%; in the case of ^{147}Pm in $^{90}Sr + {}^{90}Y$, contents above 2%, and of ^{33}P in ^{32}P, contents above 1% can be determined. (auth)

26933 IMPROVEMENTS TO RESISTIVE-WIRE FOCAL-PLANE DETECTOR. Homeyer, H.; Mahoney, J.; Harvey, B. G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Instrum. Methods; 118: No. 1, 311-312(1 Jun 1974).

A resistive-wire spectrometer focal-plane proportional-counter system has been improved by the addition of a thin-foil scintillation timing detector near the spectrometer entrance and of a second proportional counter with larger energy loss and hence better resolution. (auth)

26934 A SIMPLE METHOD FOR THE ANALYSIS OF DEPTH-SELECTIVE MOESSBAUER-EFFECT MEASUREMENTS. Baeverstam, U.; Ekdahl, T.; Bohm, C.; Liljequist, D.; Ringstroem, B. (Stockholm Univ. (Sweden). Fysiska Institutionen). Nucl. Instrum. Methods; 118: No. 1, 313-316(1 Jun 1974).

A simplified method for the analysis of depth-selective ME-spectroscopy measurements based on a use of the multichannel analyzer in the experimental set-up is described. An experimental demonstration of the use of the method is given. (auth)

26935 A MULTIPLE BETA-SINGLE GAMMA DETECTOR ASSEMBLY FOR LOW-LEVEL COINCIDENCE SPECTROSCOPY. Niese, S.; Goerner, W.; Kleeberg, H. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Nucl. Instrum. Methods; 118: No. 1, 217-220(1 Jun 1974).

A multiple beta–single gamma detector assembly offers the low background necessary for the coincidence technique and the possibility to measure several samples simultaneously with only one gamma-ray detector of good efficiency and high resolution. Detection and pulse processing as well as the decrease of the total counting time consumption and the cross-talk probabilities of the arrangement are dealt with. (auth)

26936 ANALOG SIGNAL PROCESSING FOR THE THICK RADIATOR NEUTRON SPECTROMETER. Geller, K. N.; Klein, N.; Kollarits, R. V. (Drexel Univ., Philadelphia, Pa. (USA)). Nucl. Instrum. Methods; 118: No. 1, 39-43(1 Jun 1974).

The coincident pulses from the stilbene radiator and the semiconductor recoil counters of a thick radiator telescope are processed on-line using analog techniques to provide a pulse proportional in amplitude to the energy of the neutron initiating the recoil event. Exponentiation amplifiers are used to analog the observed power law behavior of the scintillator response function to internally generated protons. An energy resolution of about 5% is measured for neutrons in the tens of MeV range. (auth)

26937 APPLICATION OF AN INTEGRATING COUNTING METHOD TO MOESSBAUER SPECTROSCOPY OF GOLD. Viegers, M. P. A.; Trooster, J. M. (Katholieke Universiteit Nijmegen (Netherlands)). Nucl. Instrum. Methods; 118: No. 1, 257-258 (1 Jun 1974).

It is shown that by an integrating counting method the acquisition speed of Moessbauer spectra of ^{197}Au is considerably increased at the expense of a relatively small loss in absorption intensity. (auth)

26938 AN AUTOMATIC COMPTON POLARIMETER FOR GAMMA ENERGIES IN THE RANGE 5–10 MeV. Arad, B.; Szichman, H. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Nucl. Instrum. Methods; 117: No. 2, 355-361(15 May 1974).

A linear polarization analyzer based on a NaI Compton polarimeter and minicomputer is described. Its use in photonuclear experiments and its reliability and advantages as compared to similar polarimeters are discussed. Polarization measurements of the ground state transition from the 8.496 MeV level in ^{90}Zr show that the transition is M1 and the deduced parity of this level is positive. (auth)

26939 ION-OPTICAL DESIGN AND FIELD SHAPING CALCULATIONS FOR THE RPI 255° MAGNETIC ANALYZER. Spaniol, G. C.; Whitehead, T. W.; White, F. A. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). Nucl. Instrum. Methods; 117: No. 2, 363-373(15 May 1974).

A large-diameter high-transmission 255° magnetic analyzer for charged particles has been constructed through field mapping studies. The analyzer is designed to operate with an energy resolution of over 1000 and a transmission factor of 0.3% of 4π sr over a ±10% energy range. The usable magnetic field extends radially from 16″ to 44″ and can exceed 5500 G across the nominal width of 4″ when operated at full power. Total weight is about 75 t and each of the four exciting coils weighs 1 t. The operating mean radius is about 28″, however the effective mean radius is twice this value due to the inhomogeneous field. This work is primarily concerned with the research and development of an optimum focusing field as described by a fifth order series expansion, and constructing the analyzer to reproduce this field. Magnetic field measurements are in good agreement with predicted theoretical results. (auth)

26940 A NEW NaI GAMMA-RAY SPECTROMETER. Hasinoff, M. D.; Lim, S. T.; Measday, D. F.; Mulligan, T. J. (British Columbia Univ., Vancouver (Canada)). Nucl. Instrum. Methods; 117: No. 2, 375-379(15 May 1974).

An improved NaI gamma-ray spectrometer has been developed for the detection of 10 to 40 MeV gamma rays. It consists of a 25.4 cm diameter × 25.4 cm long NaI cylinder surrounded by a plastic scintillator anticoincidence shield which is 10.8 cm thick. An energy resolution of 3.2% fwhm has been achieved for 15 MeV gamma-rays. It has also been observed that the uniformity of pulse-height response in large scintillators with polished surfaces is far superior to that of scintillators with surfaces which are painted white. (auth)

26941 STRUCTURAL STUDIES OF AMORPHOUS MATERIALS USING A PULSED NEUTRON SOURCE. Sinclair, R. N.; Johnson, D. A. G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment); Dore, J. C.; Clarke, J. H. (Kent Univ., Canterbury (UK)); Wright, A. C. (J. J. Thomson Physical Laboratory, Whiteknights, Reading, UK). Nucl. Instrum. Methods; 117: No. 2, 445-454(15 May 1974).

A neutron time-of-flight spectrometer using thermal neutrons produced by the Harwell electron linear accelerator (linac) has been developed to study amorphous materials. The spectrometer uses fixed-angle detectors and is operated in the wavelength range 0.3 to 3.0 Å. A major feature of the design is a backward-angle bank of detectors which gives a high detection efficiency for values of the scattering vector Q extending to greater than 30 $Å^{-1}$. The technique is compared with conventional reactor methods and preliminary results are presented for liquid nitrogen, vitreous germania and nickel powder. (auth)

High Energy Physics Instrumentation

Refer also to abstract 27585.

26942 (RL-74-094) LOW MASS CYLINDRICAL SPARK CHAMBER WITH CAPACITY READ-OUT. Arnison, G. T. J. (Science Research Council, Chilton (UK). Rutherford Lab.). Jun 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The manufacture and performance of a J-shaped low mass wire spark chamber is described. The chamber was designed to surround a polarized proton target and cover the maximum acceptance possible inside the magnetic field for studying the $\bar{p} + p\uparrow \rightarrow \pi^+ + \pi^-$ interaction. The drift due to the magnetic field is discussed. (auth)

26943 SPARK GAMMA TELESCOPE FOR COSMIC GAMMA RADIATION. Gal'per, A. M.; Kurochkin, A. V.; Leikov, N. G.; Luchkov, B. I.; Yurkin, Yu. T. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 45-47(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 50-52(1974).

A high-aperture-ratio γ telescope is described having optical spark chambers, which is designed for operation on-board artificial earth satellites and high-altitude balloons. The instrument consists of multigap spark chambers and a counter telescope. Gamma quanta having an energy >40 MeV are recorded. The geometric factor of the instrument for an isotropic flux is 115 $cm^2 \cdot sr$; the geometric recording area is 250 cm^2. For flight of a gamma telescope on a high-altitude balloon approximately 12,000 events were recorded. (auth)

26944 READ-OUT SYSTEM FOR WIRE PROPORTIONAL CHAMBERS. Berst, J. D.; Chatelus, Y.; Meyer, J. M.; Metzger, G.; Schultz, G. (Centre National de la Recherche Scientifique, 67-Strasbourg (France)). Nucl. Instrum. Methods; 117: No. 2, 513-518(15 May 1974). (In French).

A MWPC readout system is described which is intended for the hyperon experiments at CERN. Its structure is like the familiar CAMAC branch highway, but driven by a spark chamber readout module placed in CAMAC. The different parts of the equipment, which may read up to 4096 wires, and the test system are described. (auth)

26945 A LOW-DENSITY, CYLINDRICAL MWPC WITH SIMULTANEOUS ANODE AND CATHODE READ-OUT FOR USE IN A MAGNETIC DETECTOR. Jeanjean, J.; Jeanjean, M.; Madaras, R.; Masnou, J. L.; Perez-Y-Jorba, J.; Quenzer, A.; Rumpf, F.; Bertrand, J. L.; Bizot, J. C.; Chase, R. L. (Lab. de l'Accelerateur Lineaire, Univ. de Paris-Sud. Orsay, France). Nucl. Instrum. Methods; 117: No. 2, 349-354(15 May 1974).

The construction and performance of a cylindrical proportional chamber with anode and cathode detection permitting simultaneous axial and azimuthal localization without ambiguity is described. The anode wires are strung parallel to the chamber axis, while the inner and outer cathode wires form helices inclined at -45° and +45°, respectively. The average chamber thickness is 10^{-3} radiation lengths. At 100% efficiency the anode and cathode plateau widths are 600 and 300 V, respectively. (auth)

26946 A LEAD-GLASS CHERENKOV DETECTOR FOR ELECTRONS AND PHOTONS. Beale, J. S.; Buesser, F. W.; Camilleri, L.; Di Lella, L.; Gladding, G.; Placci, A.; Pope, B. G.; Smith, A. M.; Smith, B.; Yoh, J. K. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 117: No. 2, 501-508(15 May 1974).

An apparatus for the detection of high-energy electrons and photons is described. Lead-glass Cherenkov counters measure the energies, and charged particle tracks are reconstructed using an array of wire spark chambers. The mode of operation, calibration, and stability of the system are described and details are given of the ability to discriminate electrons from hadrons. (auth)

26947 SCINTILLATION COUNTER HODOSCOPE ARRAYS FOR ACCURATE LOCATION OF PARTICLE TRAJECTORIES IN MAGNETIC SPECTROMETERS. Collins, M. W.; Groome, A. E.; Norton, P. R. (Science Research Council, Daresbury (UK). Daresbury Lab.). Nucl. Instrum. Methods; 117: No. 2, 339-344(15 May 1974).

The development of a fast scintillation counter hodoscope in compact form for use in magnetic spectrometers is described. Results from its application to study the electroproduction of the π^+ meson near threshold are discussed. (auth)

26948 THE USE OF A SMALL DIGITAL COMPUTER IN POSITION DIGITISING AND SERVO CONTROL OF FILM MEASURING MACHINES. Miller, D. B.; Price, D. R.; Stark, J. (Imperial Coll. of Science and Technology, London (UK). Dept. of Physics). Nucl. Instrum. Methods; 117: No. 2, 551-559(15 May 1974).

A minicomputer is used to implement digitising and servo control of the movable stages of projection-microscope measuring machines for measurements of images on bubble chamber film. Wherever possible, functions traditionally performed by special purpose digital or analogue electronics are effected by the computer program, thereby minimising external hardware. "Count up" and "count down" pulses from incremental digitisers are totalled directly in computer memory using an externally triggered "memory increment" feature. A non-linear servo program, making use of the position and velocity information thus available in the computer memory, moves the stages to any desired point, obtaining optimum response by using phases of constant acceleration and deceleration. The computing power of the general purpose processor allows simple performance of several auxiliary functions with no extra hardware. (auth)

26949 A SCRATCH PAD MEMORY FOR BUFFING MULTIWIRE PROPORTIONAL CHAMBER DATA. Brown, D. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 117: No. 2, 561-567(15 May 1974).

A scratch pad memory has been developed for rapidly acquiring a series of data words from a group of multiwire proportional chambers. Use of this memory for buffering reduces the effective dead time in experiments involving high instantaneous event rates. (auth)

26950 FAST DIGITAL CODER CONNECTED WITH THE CAMAC DATAWAY FOR HODOSCOPE SYSTEMS. Basiladze, S. G.; Guzik, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). Nucl. Instrum. Methods; 118: No. 1, 285-288(1 Jun 1974).

A digital 32-channel BCD coder for the cases when one and only one wire in a proportional chamber was fired is described. The unit has the possibility to transfer input data via a CAMAC dataway. The maximum number of coded channels is up to 2^5-1 and the minimum coding time is about 160 ns. (auth)

26951 OPERATIONAL CHARACTERISTICS OF LOW-PRESSURE NEON FLASH TUBES. Bhattacharyya, D. P. (Indian Association for Cultivation of Science, Calcutta). Nucl. Instrum. Methods; 118: No. 1, 289-291(1 Jun 1974).

The dependence of flash-tube efficiency on the pressure, tube diameter and pulse delay time has been studied in the pressure range 0.5 to 1.05 atm of neon. It is found that the efficiency increases with the product of pressure and tube diameter, and with decreasing pulse delay time. The efficiency also decreases with increasing rise time of the pulse. The threshold voltage of the flash tubes follows Paschen's law. (auth)

26952 A UNIFORM-FIELD MICROWAVE DISCHARGE CHAMBER AS A HIGH-ENERGY PARTICLE-TRACK DEVICE. Kustom, R. L.; Fuja, R. E. (Argonne National Lab., Ill. (USA)). Nucl. Instrum. Methods; 118: No. 1, 203-211(1 Jun 1974).

An experimental model of a new type of high-energy particle-track illuminating device based on the microwave discharge principle has been successfully tested. The salient feature of the device is the addition of dielectric material along the waveguide walls in order to produce uniform fields over the gaseous volume. The latter represents a substantial improvement over previous models of microwave discharge chambers. Good-quality tracks were obtained with a peak rf field of 0.5 MV/m at 1300 MHz. Track quality was similar to higher-frequency discharge chambers, which clearly demonstrated that the low-frequency limit has not yet been reached. Calculations indicate that frequencies at least as low as 300 MHz should be possible. Since chamber size is inversely proportional to frequency, the low-frequency limit for good track resolution is an important consideration. Ideally, a large-volume, dense-gas device should be possible, fully exploiting the lack of average drift velocity of liberated ions by exciting the chamber in a resonant system. (auth)

26953 A MULTIWIRE PROPORTIONAL CHAMBER SYSTEM FOR USE IN A STORAGE RING EXPERIMENT. Rand, R. E.; Hughes, E. B.; Kose, R.; Martin, T. W.; MacGregor, W. I.; Schilling, R. F. (Stanford Univ., Calif. (USA). High-Energy Physics Lab.). Nucl. Instrum. Methods; 118: No. 1, 189-202(1 Jun 1974).

A multiwire proportional chamber system is described which has been used successfully in an experiment at the 2.6 GeV electron-positron storage ring (SPEAR) at the Stanford Linear Accelerator Center. Detailed descriptions of the chamber construction and test procedures are given, together with a description of the electronic read-out circuitry. The performance of the system during the experiment is reported and on-line displays of typical events are shown. (auth)

26954 THE GEOMETRICAL RECONSTRUCTION OF EVENTS FROM TRACK-SENSITIVE TARGETS. Fisher, C. M.; Guy, J. G. V.; Wignall, J. W. G. (Science Research Council, Chilton (UK). Rutherford Lab.). Nucl. Instrum. Methods; 118: No. 1, 171-176(1 Jun 1974).

Over 10,000 events have been measured in a bubble-chamber experiment with a track-sensitive hydrogen target surrounded by a neon-hydrogen mixture. This paper describes the methods used in reconstructing the momenta and angles of outgoing hadron tracks passing through both hydrogen and neon-hydrogen, and in calculating gamma-ray momenta and angles from the observed electron pairs. The results indicate that the track-sensitive-target technique has an accuracy similar to an ordinary hydrogen bubble chamber. (auth)

26955 SILICA AEROGELS USED AS CHERENKOV RADIATORS. Cantin, M.; Casse, M.; Koch, L.; Jouan, R.; Mestreau, P.; Roussel, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service d'Electronique Physique); Bonnin, F.; Moutel, J.; Teichner, S. J. (Lyon-1 Univ., 69 (France)). Nucl. Instrum. Methods; 118: No. 1, 177-182(1 Jun 1974).

Silica aerogel is a porous and transparent solid material. Its index of refraction is a function of its density, and it can be freely adjusted between at least 1.01 and 1.06, and up to values as high as at least 1.20 by heating. As a Cherenkov radiation it replaces gases under high pressure, eliminating all the problems associated with their container. (auth)

26956 THE SWEEPNIK SYSTEM-PERFORMANCE. Brown, C. R.; Elcombe, P. A.; Lang, J. A.; Raja, R. (Cambridge Univ. (UK). Cavendish Lab.). Nucl. Instrum. Methods; 118: No. 1, 183-188(1 Jun 1974).

The performance of the Sweepnik measuring device is discussed, using data from several bubble chamber experiments in the momentum range 1 to 20 GeV/c, and it is compared with that of the conventional manual machines in use at Cambridge. (auth)

Radiometric Instruments

Refer also to abstract 27005.

26957 (PB-228976) STRUCTURE BACKFILL TESTING. Final Report. Hatano, M. M.; Hirsch, A. D.; Forsyth, R. A. (California State Div. of Highways, Sacramento (USA)). Nov 1973. 65p. NTIS $6.25.

The study was performed because of concern that the nuclear gage did not measure the density of structure backfill accurately due to the effect of concrete walls or pipes. Field and laboratory studies indicated that the gage is able to give a good estimate of the inplace density and that wall effect is not significant if the test is properly performed. Field correlation tests between sand volume and nuclear methods indicated the sand volume tended to give slightly higher test results. Laboratory research also indicated the sand volume tends to measure above the true density when the density of the material is above 120 lb/ft^3. This study indicated the relative compaction specification of 95% be retained. (GRA)

26958 RADIOMETRIC MEASURING METHODS. Merkle, R. (Verein Deutscher Ingenieure, Duesseldorf (F. R. Germany)). Chem.-Anlagen Verfahren; 164: No. 4, 71-76(Apr 1973). (In German).

8 figs.; 8 refs.

The work gives a report on radiometric measuring methods in the manufacture and drying of polymers in spinning factories and other factories of the textile industry. The specific suitability of radiometric methods and their advantages compared to conventional methods are discussed. (GE)

26959 NONDESTRUCTIVE MEASUREMENT OF THE COATING THICKNESS OF PLAIN BEARING RACES. Steeg, M. (Glyco-Metall-Werke Daelen und Loos G.m.b.H., Wiesbaden (F.R. Germany). Zentrallaboratorium). Metalloberflaeche; 28: No. 4, 127-134(Apr 1974). (In German).

15 figs.; 1 tab.; 8 refs.

Coating thickness measurements are described using the beta backscattering method (Betascope) on electrodeposited Pb/Sn/Cu layers on lead bronze or Pb/Sn-Flash on steel, mainly with the measurement of the ternary layer. The mean atomic number of the ternary alloy is determined for the selection of the suitable beta emitter (in this case ^{147}Pm). Furthermore, the influence of the parameters of Sekowski's equation (geometry, physical-chemical parameters) are studied, the preparation of the calibration standards is described, and the influence of multiple measurements and the measuring time on the accuracy are determined. The method is successfully employed in production control. (GE)

26960 MONTE CARLO SIMULATION OF PHOTONS IN TWO-LAYERED MEDIA FOR DENSITY GAUGES. Christensen, E. R. (Danmarks Tekniske Hoejskole, Lyngby). Comput. Phys. Commun.; 7: No. 4, 185-191(Apr 1974).

Multiple photon scattering in a two-layered medium is considered. The photons are assumed to originate from a mono-energetic point source situated at an arbitrary height over the medium. The relative number of backscattered photons, weighted with a detector efficiency spectrum, is calculated in consecutive radial intervals. Photons are simulated by the Monte Carlo method. Stratified sampling is applied to the isotropically emitted source photons. The scattering angle is determined by iteration from the Klein–Nishina cross section. (auth)

26961 COMPUTER SIMULATION OF PHOTONS IN SPHERIC MEDIA FOR DENSITY GAUGES. Christensen, E. R. (Danmarks Tekniske Hoejskole, Lyngby). Comput. Phys. Commun.; 7: No. 4, 192-199(Apr 1974).

Multiple photon scattering in a spheric medium is considered. The photons are assumed to originate from a mono-energetic point source situated at the center. The relative photon track length, weighted with a detector efficiency spectrum, is calculated in consecutive radial intervals. In order to contribute to the track length, the elements of the photon paths must form an angle with the radius vector which is greater than a specified cut-off angle. Photons are simulated by the Monte Carlo method. The scattering angle is determined by iteration from the Klein–Nishina cross section. A least-squares fit of an analytical expression to the calculated results is performed. (auth)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 27540.

26962 (AD-776671) AECO (AUTOMATIC ELECTRIC COMPANY) AUTOVON (AUTOMATIC VOICE NETWORK) SWITCH HEMP (HIGH ALTITUDE ELECTROMAGNETIC PULSE) PERFORMANCE STUDY. Final Report (Volume 1), July 1972–February 1974. Clark, E. N.; Frost, J. A. (Stanford Research Inst., Menlo Park, Calif. (USA)). Feb 1974. Contract DCA100-72-C-0042. 185p. (SRI-2032). NTIS $5.50.

A description of the AECO AUTOVON switch and a preliminary assessment of switch vulnerability to HEMP in twenty critical circuits are presented. The switch description covers the physical arrangement, the functional operations of the various subsystems in processing a call, the synchronization and timing of subsystem functions, and the automatic maintenance and diagnostic features of the switch. The vulnerability assessment takes into consideration the wiring, the interconnecting cable locations and lengths, and the component card circuits. The expected failure mode of each critical circuit is included. (auth)

26963 RADIATION SENSITIVITY AND AMORPHOUS MATERIALS, PRESENT, AND FUTURE. Holmes-Siedle, A. G. Rep. Progr. Phys.; 37: No. 6, 699-769(1974).

Amorphous forms of semiconductors and insulators are increasingly used in various electronic devices and in other technologically advanced materials such as laser hosts and light guides. These devices will sometimes be required to retain their performance while under heavy irradiation by high energy particles and photons. With a view to guiding future physical research, the impact of such irradiation on the functional properties of amorphous materials in a wide range of practical applications is reviewed systematically. After defining some environments, a list of about sixty classes of electronic and optical devices is b broken down into subelements and the occurrence, role and irradiation problems of the amorphous sub-elements are discussed and analyzed as well as the more general problems of producing tolerance to radiation in devices. The detailed analysis leads to a set of balanced recommendations for future physical research on the amorphous state in fields which will support the development of a radiation-tolerant device technology. (auth)

26964 COMPARISON OF RADIATION STABILITY OF PHOTOELEMENTS OF DIFFERENT CONSTRUCTION. Vasil'ev, A. M.; Barto, M. P. Tr. Mosk. Energ. Inst., Fiz.; No. 144, 79-86(1972). (In Russian).

A theoretical comparison of silicon photoelements of different thicknesses showed that the most stable to proton bombardment was a thin photoelement, with the resistance sharply increasing as the thickness decreased. However the manufacture of very thin photoelements is very difficult. From the results obtained the service life of the different types could be estimated under specific conditions. (tr-auth)

26965 REGENERATION OF NEUTRON-DAMAGED Ge(Li) DETECTORS INSIDE THE CRYOSTAT. Baader, R.; Patzner, W.; Wohlfarth, H. (Technische Univ. Darmstadt (F.R. Germany). Inst. fuer Kernphysik). Nucl. Instrum. Methods; 117: No. 2, 609-610 (15 May 1974).

A simple and fast procedure is described allowing the regeneration of Ge(Li) detectors remaining in the cryostat. The technique is suitable for the restoration of the detector properties after damage by fast neutrons or deterioration following a vacuum breakdown or erroneous warming-up. (auth)

Miscellaneous Instruments

Refer also to abstracts 26560, 26716, and 27456.

26966 (CONF-730907-P1, pp 106-111) CALIBRATION FACILITY FOR MICROWAVE MONITORS: DESIGN AND OPERATING EXPERIENCE. Leith, I. S. (Australian Radiation Lab., Melbourne). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A broad-band microwave calibration facility was designed and partly completed. Evaluation of the facility and its progressive design are described and calibration results presented. (auth)

26967 (CONF-730907-P2, pp 1127-1132) DOSE REDUCTION BY ELECTRONIC RADIOGRAPHY. Sashin, D.; Heinz, E. R.; Sternglass, E. J. (Univ. of Pittsburgh). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

High resolution electronic radiography has been developed for use in diagnostic radiographic and fluoroscopic procedures. These methods are being developed for IVP pelvimetry, intrauterine transfusions, gastrointestinal examinations, stereotaxic procedures, and selective catheterization. Preliminary clinical data show that dose reduction can range from 10 to 10,000 times depending on the resolution requirements of the particular examination. (auth)

26968 (COO-3040-1) DESIGN AND CONSTRUCTION OF A DETECTION SYSTEM FOR DETERMINATION OF LEAD IN BLOOD USING LOW ENERGY X-RAY FLUORESCENCE ANALYSIS. Laurer, G. R.; Kneip, T. J.; Wrenn, M. E.; Eisenbud, M. (New York Univ., N. Y. (USA). Inst. of Enviromental Medicine). 1 May 1972. Contract AT(11-1)-3040. 65p. Dep. NTIS $6.25.

The results of work devoted to the design and construction of a detection system for the determination of lead in blood using X-ray fluorescence analysis with a radioisotope excitation source are presented. The objective of the research was to provide a transportable detection system which can be used as a mass screening device for the detection of lead in blood. The research parameters set up were for a system which would allow detection of blood lead levels in the "normal" range (0.2 to 0.4 ppM), using an amount of blood obtainable with a finger prick sampling technique, requiring a minimum of sample preparation and a reasonably short analysis time. A system has been developed and tested experimentally which has a detection limit of 0.26 ppM, using a sample volume of 150 μl and an analysis time of five minutes. Sample preparation involves centrifugation of the 150 λ hemotocrit tubes used to collect the blood sample. Projected detection limits indicate a limit of 0.23 ppM with a one-minute analysis time is possible. The system utilizes a Si(Li) detector and a ^{238}Pu source. System requirements are discussed for three possible modes of use of the detector, mass screening, research, and automated. System specifications for the three modes of use are included. (auth)

26969 (JUL-1060-AT) CONTRIBUTION CONCERNING THE TEMPERATURE MEASURING ERROR OF TEMPERATURE PROBES DUE TO HEAT CONDUCTION BETWEEN THE TEMPERATURE PROBE AND THE OBJECT TO BE MEASURED. Leyers, H. J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Allgemeine Technologie). Apr 1974. 64p. (In German). INIS.

21 figs.; 1 tab. with abstract.

A theoretical model explaining the temperature measuring error due to heat exchange and other heat sources of a cylindrical temperature probe is presented and demonstrated by a practical test with the aid of a computer program. (GE)

26970 (UCID-15314) SOIL STRESS GAGE CONCEPT. D'Arcy, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Mar 1968. Contract W-7405-eng-48. 66p. Dep. NTIS $6.50.

The design of a soil stress gage is presented that allows the gage to become stiffer with applied stress in a manner similar to soil. A program was written to compute a calibration curve for any gage configuration. The gage proposed consists of a balloon filled with a fluid and contained by a ring and two diaphragms to measure a stress vector parallel to its axis. In operation, the diaphragm plates are depressed, the fluid compresses, and the ring expands outward against the soil. It is advisable to fill the gage with mercury whose compressibility is close to that of rock. The theory behind the gage concept, an analysis of the gage's dynamic response, a proposed test program, and the listing of the calibration computer program in Annex A are presented. (MCW)

26971 (UCID-15359) PASSPORT PROGRAM. Quarterly Technical Progress Summary No. 3 (April-June 1968). Salisbury, J. D.; Gustavson, M. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1968. 23p. Dep. NTIS $4.25.

Summary of the progress made on the Geographic Position Locator system is presented for the gyro development, accelerometers development, system temperature, electronic and component study, computer study for GPL-B, GPL-A procurement, and the simulation data analysis. It was reported that the most significant progress was the exceptionally successful testing of new gyro spin bearings. These use beryllia and boron carbide on the gimbal and spin wheel respectively. The 86,000 successful stop-start tests using this combination can be compared to the best performance of the alumina bearing assemblies that tested for 14,000 cycles before failure. (MCW)

26972 (UCID-15399) PASSPORT PROGRAM. Quarterly Technical Progress Summary No. 4 (July-September 1968). Salisbury, J. D.; Gustavson, M. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1968. 37p. Dep. NTIS $5.00.

Technical progress on development of the GPL is reported. Initial testing of the LTN-51 part of the GPL-A system involves being run in a stationary mode to establish performance in a benign environment. The GPL-A system combines primarily a commercially developed inertial navigation system and an additional digital computer of considerable capability. The WISPIN computer program developed to simulate an INS was used to simulate the LTN-51 part of the system. Initial runs revealed that constant gyro bias errors are the dominant error source affecting the mean position and velocity performance of the system. Progress is reported on a scheme for damping the oscillations of an INS and application of Kalman filtering to the GPL system. Development of a small accelerometer and gyro is described. (MCW)

26973 (UCID-15455) PASSPORT PROGRAM. Quarterly Technical Progress Summary No. 5 (October-December 1968). Salisbury, J. D.; Gustavson, M. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Mar 1969. 56p. Dep. NTIS $6.00.

The technical progress on development of the Geographic Position Locator (GPL) System includes the efforts of LRL, the MIT Instrumentation Laboratory, and the Analytic Sciences Corporation. A new low-thermal-resistance gimbal design concept, a low-power temperature controller, Kalman Filtering, and motion sensing are described. (MCW)

26974 (UCID-15514) PASSPORT PROGRAM. Quarterly Technical Progress Summary No. 7 (April-June 1969). Salisbury, J. D.; Gustavson, M. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1969. 29p. Dep. NTIS $4.50.

The technical progress on development of the Geographic Position Locator by LRL, the MIT Instrumentation Laboratory, and the Analytic Sciences Corporation is reported on thermal control systems, sub-optimal Kalman filter application to the GPL-A, the 12 permanent magnet pulsed integrating pendulum (PM PIP), motion sensors, and GPL-A software. (MCW)

26975 (UCID-15603) PASSPORT PROGRAM. Quarterly Technical Progress Summary No. 9 (October-December 1969). Salisbury, J. D.; Gustavson, M. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1970. 23p. Dep. NTIS $4.25.

The technical progress on development of the Geographic Position Locator (GPL) system by LRL, the MIT Instrumentation Laboratory, and the Analytic Sciences Corporation is reported. Thermal control systems, gyro-biasing schemes, motion sensing, and IMU (Inertial Measuring Unit) configurations are discussed. Activities dealing with the conceptualization, analysis, and evaluation of the GPL system; developments and design of hardware for use in a GPL system; development and design of software for use in either the LTN-51 or an advanced GPL system; and planning, operating, and maintaining the mobile test facility and the WISPIN computer simulation program are reported. (MCW)

26976 (UCID-15414) TRLR 31 TEMPERATURE-MONITORING SYSTEM USED FOR LANPHER AND HUPMOBILE EVENTS. Baty, R. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Nov 1968. 14p. Dep. NTIS $4.00.

A newly designed temperature-monitoring system was fielded for the first time in October 1967. This was a twelve-channel system located in Trailer 31, 4000 ft north-northeast of ground zero. The purpose of the system was to monitor the temperatures of several oil-filled velocity-gauges used to measure ground motion. An accurate record of the temperatures of these velocity gauges was needed because of temperature-induced changes in the viscosity of the oil and, hence, a shift in calibration of these gauges amounting to about 1-percent per degree Fahrenheit. The gauges were located at ground zero and in the trailer park on Lanpher, both above and below ground. The temperature-monitoring system appears to be capable of maintaining an accuracy of ±1°C over long cable runs. The design of the system, the recording and reduction of data, and errors are discussed. (auth)

26977 (UCID-15702) DIGITAL CONVERSION OF TWO-DIMENSIONAL ANALOG DISPLAYS. Wouters, L. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Aug 1969. 11p. Dep. NTIS $4.00.

Developmental progress of two-dimensional scanning arrays of sub-miniature photosensitive devices with particular application to analysis of two-dimensional analog data is reported for stored and real-time displays with their corresponding hardware variants. Stored displays have no severe scan time restrictions. The digitizing scheme involves projection of an image of the 2-D exhibit onto a photoresistive matrix. This is sequentially scanned by electronic

methods for the binary light or dark condition of each array element. Synchronized signals are included in the tape recording of the linearized array output. Application to EMP traces will be made. Real-time displays involve limitations in scanning time. A display may change time-wise as a complete frame, or as an evolving scene. Examples include the outputs of a simple image amplifier or of a fast sweep oscilloscope. Scan time or sensitivity constraints usually dictate the use of three-element array elements (photo-transistors). (MCW)

26978 (UCRL-75623) X-RAY FLUORESCENCE EXPERIMENTS WITH POLARIZED X RAYS. Howell, R. H.; Pickles, W. L.; Cate, J. L. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jul 1974. 10p. (CONF-740809-5). Dep. NTIS $4.00.

From 23rd annual conference on applications of x-ray analysis; Denver, Colorado, USA (7 Aug 1974).

Two methods of obtaining polarized x rays for fluorescence experiments are discussed. Compton scattering from a low-Z scatterer is the usual method used in such experiments. The polarization of x rays undergoing anomalous Borrman transmission in a dislocation-free crystal is also described and preliminary results are presented. Approximate expressions, useful for comparing scatter-polarizing systems, are derived for the dependence of scatter rejection and fluorescent efficiency on two scattering-system parameters: the thickness of the scattering polarizer and the geometric limit to solid angles and angular divergences in the system. (auth)

26979 METHOD FOR THE NUMERICAL EVALUATION OF THE PERFORMANCE OF MASS ANALYSIS INSTRUMENTS EMPLOYING ARBITRARY ION OPTICS. Birtles, A. B. (Water Resources Board, Reading, Eng.); Mellor, D. J. J. Phys., D (London); 7: No. 10, 1351-1360(Jul 1974).

A generally applicable method is proposed for the computation of the dispersion and resolution of mass analysers using a linear perturbation technique. The method should prove invaluable when simple expressions for the resolving power of a particular instrument, existing or proposed, are not available, or if the presence of non-ideal fields or injected ion beam imperfections has a significant influence on performance. Techniques are illustrated by the computation of the output dispersion characteristics and resolving power of a quadrupole configuration employing eccentric circular exit apertures of various diameters. (auth)

26980 USE OF DIGITAL DISCRIMINATORS FOR PRELIMINARY TAKEOFF OF INFORMATION IN TWO-DIMENSIONAL ANALYSIS. Medved, S. V.; Sinaev, A. N.; Khaupt, Kh.; Tsakher, G. Yu.; Chelnokov, L. P. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 68-71(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 68-71(1974).

A device is described for preliminary takeoff of information by means of digital discriminators. The device contains 16 digital discriminators which determine the lower and upper boundaries of the sectors of the spectrum which are recorded in the storage device. One may carry out two-dimensional and three-dimensional measurements. As an example of the use of the device in the two-dimensional mode, an investigation is made of the decay diagram of the ^{127}Ba isotope for determining the lifetime of one of the excited states. (auth)

26981 DISCRIMINATOR FOR SINGLE EVENTS. Morozov, A. G. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 77-81(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 76-80(1974).

The circuit of a discriminator of single events is described which allows a substantial reduction of the distortion of the spectrum of the time intervals that develop as a result of the superposition of several events in an investigated time interval. Results of checking the circuit are presented. (auth)

26982 TRENDS IN NUCLEAR INSTRUMENTATION. Andrews, I. (Brandenburg Ltd., Nuclear Engineering Division, Ger.). Electron. Power; 20: No. 14, 562-565(8 Aug 1974).

The use of nucleonic techniques by a diverse range of customers and industries produces particular and possibly unique problems. Each customer working in his own particular field, whether it be medicine, industrial control, chemical, or materials analysis, has a completely individual requirement in nucleonic specifications. The modular concept for instrumentation, called CAMAC, facilitates the interfacing of data from general nucleonic instrumentation into an online computer. To overcome difficulties caused by the possible failure of a company who produces a certain modular system, the US Atomic Energy Commission produced a specification for a modular system N.I.M. (Nuclear Instrumentation Modules). The future development of this system is discussed. The UKAEA has developed a care-frame system of nuclear instrumentation that is intended to be put together by the manufacturers into discrete instruments. Some examples of this instrumentation are given. (UK)

26983 ENERGY DISTRIBUTION OF OUTPUT ELECTRONS IN A CURVED CHANNEL MULTIPLIER. Loubet, D.; Barat, C. (Toulouse-3 Univ., 31 (France). Centre d'Etude Spatiale des Rayonnements). Nucl. Instrum. Methods; 118: No. 1, 259-262 (1 Jun 1974).

The energy distribution of secondary electrons was measured at the output of a Bendix type 4010 curved channel multiplier for different values of the angle of electron emergence with respect to the tube axis. The results obtained illustrate the different types of trajectories and their contribution to the amplification of the electron cloud as a function of voltage. The hypothesis that the terminal charge is statistically limited for voltage of about 3 kV is confirmed by the good correlation between the measured maximum energies of different spectra and those predicted theoretically. (auth)

26984 CORRECTION FOR COUNTING LOSSES IN MULTICHANNEL TIME ANALYZERS. Chwaszczewski, S.; Mikulski, A. T. (Institute of Nuclear Research, Warsaw (Poland)). Nucl. Instrum. Methods; 118: No. 1, 227-230(1 Jun 1974).

The formulae expressing corrections for dead-time losses, for measurements performed with multichannel analyzers operating in time mode are derived. The reasoning concerns analyzers in which the dead time is variable, from the moment of the pulse arrival till the moment when the memory cycle is finished. A series of measurements has been carried out to check if the formulae are correct. (auth)

26985 A DIGITAL METHOD FOR REACTOR-PERIOD MEASUREMENT. Mundim, S. G. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Nucl. Instrum. Methods; 118: No. 1, 273-278(1 Jun 1974).

A digital method to measure the period of a nuclear reactor is described which is derived from the definition formula of the period. The instrument, whose basic circuit is explained, is able to process the period every 8s, with a self-adapting accuracy circuit which keeps the errors at their minimum values. Integrated circuits are used, allowing for simple and cheap assembling. (The method was developed as a requisite for a Master of Science degree at COPPE, Federal University of Rio de Janeiro, Brazil, in February 1971.) (auth)

26986 A DYNAMICALLY REGULATED LEVITATION ELECTROMETER USED IN A SEARCH FOR FRACTIONAL CHARGES. Garris, E. D.; Ziock, K. O. H. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Nucl. Instrum. Methods; 117: No. 2, 467-475(15 May 1974).

A levitation electrometer based on the dynamic magnetic suspension method of Beams has been developed. The electrometer was used to measure the residual charge of twelve small (0.2 mm diam.) steel balls. A charge distribution was found that was suggestive of the existence of fractional charges. The systematic errors that could have caused such a distribution are discussed. (auth)

26987 AN APPLICATION OF THE BATEMAN EQUATIONS FOR CALCULATING ACTIVITIES IN STREAMING SYSTEMS. Baechmann, K.; Buettner, K.; Niedhart, B. (Technische Univ. Darmstadt (F.R. Germany). Fachbereich Anorganische Chemie und Kernchemie). Nucl. Instrum. Methods; 117: No. 2, 397-399 (15 May 1974). (In German).

The following study shows the applicability of Bateman-equations for calculating the activities of nuclides belonging to one decay chain, the nuclides being continuously formed and transported with different velocities. The calculation of the activities in a certain distance is possible after substitution of the parameters half-life and transportation time by "half-distance" (half-life x transportation velocity of the respective nuclide) and the distance that has been covered. (auth)

26988 TIMING AND AMPLITUDE CHARACTERISTICS OF A PARALLEL-PLATE ELECTRON MULTIPLIER. Berg, S.; Eriksson, B. (Uppsala Univ. (Sweden). Fysiska Institutionen). Nucl. Instrum. Methods; 117: No. 2, 345-347(15 May 1974).

The amplitude distributions and time durations of current pulses in a parallel-plate electron multiplier (PPEM) are reported. The performance of the PPEM and the channel electron multiplier (CEM) are compared and the differences in behavior are pointed out. (auth)

26989 A NEW TANDEM MASS SPECTROMETER FOR THE STUDY OF ION-MOLECULE REACTIONS. Smith, D. L.; Futrell, J. H. (Utah Univ., Salt Lake City (USA). Dept. of Chemistry). J. Mass Spectrom. Ion Phys.; 14: No. 2, 171-181(Jul 1974).

Essential design and construction details and some preliminary results are given for a new tandem mass spectrometer which was designed for the study of low (approximately thermal) energy ion-molecule reactions. The first stage of the instrument consists of a 180 degree, 5.7 cm radius magnetic mass spectrometer which provides a beam of mass analyzed reactant ions. The second stage of the instrument consists of a deceleration lens and an ion cyclotron resonance mass spectrometer. A moderately high pressure source in the first stage of the instrument permits studies of reactant ions which are themselves products of ion-molecule reactions. Differential pumping isolates the ion source from the collision region and therefore permits detailed studies of internal effects on ion-molecule reactions. (auth)

26990 REGULATED MAGNETIC PEAK SWITCHING FOR ELECTRICAL DETECTION ANALYSIS BY SPARK SOURCE MASS SPECTROMETRY. Degreve, F.; Figaret, R. (Compagnie de Produits Chimiques et Electrometallurgiques Pechiney, Centre de Recherches de Voreppe, 38 (France)); Le Goux, J. J.; Calavrias, L. (Thomson-CSF, 78-Chatou (France)). J. Mass Spectrom. Ion Phys.; 14: No. 2, 183-187(Jul 1974).

A Servo-Gauss system is described suitable for measuring and controlling a magnetic field. When it is attached to a commercial mass spectrometer a good signal stability and a fast commutation between preselected isotopes allows precise and easy location of the peaks. (auth)

26991 A STUDY ON MASS DISCRIMINATION IN A MAGNETIC SECTOR MASS SPECTROMETER. Werner, H. W. (Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands)). J. Mass Spectrom. Ion Phys.; 14: No. 2, 189-204(Jul 1974).

The effect of voltage scanning on the extraction of ions from a simplified Nier type ion source, the function of the repeller and the effect of space charge have been studied. It is also shown that, due to the choice of small dimensions for the ion source and the proper choice of electric and magnetic fields in the ion source, the influence of the source magnetic field on the ion trajectories can be neglected. A modified ion source is described in which the mass discrimination occurring under the condition of voltage scanning has been reduced. The conditions under which the initial thermal velocity may be neglected are discussed. Mass discrimination has been studied theoretically and experimentally, based on a study of computer-calculated ion trajectories. (auth)

26992 SPACE AND VELOCITY FOCUSING IN TIME-OF-FLIGHT MASS SPECTROMETERS. Stein, R. (Pennsylvania State Univ., University Park (USA). Dept. of Physics). J. Mass Spectrom. Ion Phys.; 14: No. 2, 205-218(Jul 1974).

A focusing equation is developed describing the relationship between space and velocity focusing for all one-dimensional time-of-flight mass spectrometers with constant electric fields. As a result of this equation, first order double time focusing in one dimension is impossible. The possibility of large improvements in the resolving power of the time-of-flight mass spectrometers is discussed on this basis. The focusing equation also leads to an expression for the minimum time resolution obtainable. This second equation is applied to the conventional Wiley and McLaren two-field time-of-flight mass spectrometer with and without time-lag focusing, and to the mirror instrument of Karataev et al. (auth)

26993 DOUBLE FOCUSING MASS SPECTROMETERS OF SECOND ORDER. Matsuda, H. (Osaka Univ., Toyonaka (Japan). Coll. of General Education). J. Mass Spectrom. Ion Phys.; 14: No. 2, 219-233(Jul 1974).

The possibilities of correcting for second order image aberrations of a double focusing mass spectrometer are investigated. Six coefficients of the second order aberration, $A_{\alpha\alpha}$, $A_{\alpha\delta}$, $A_{\delta\delta}$, $A_{\gamma\gamma}$, $A_{\gamma\delta}$, $A_{\beta\beta}$, are calculated considering the influence of the fringing field and the conditions for complete second order focusing ($A_\alpha = A_\delta = A_{\alpha\alpha} = A_{\alpha\delta} = A_{\delta\delta} = A_{\gamma\gamma} = A_{\gamma\delta} = A_{\beta\beta} = 0$) are sought. The results of the calculations and values for the parameters of the various arrangements are described. It would be possible to construct a complete second order double focusing mass spectrometer consisting of a toroidal electric field and a homogeneous magnetic field or of a cylindrical electric field plus an electrostatic quadrupole lens and a homogeneous magnetic field. The latter configuration would be advantageous because the vertical focusing is better. Straight boundaries of the magnetic field are adopted for practical reasons. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 26522 and 27576.

26994 (AD-774201) EFFECTS OF COLUMN ASYMMETRY ON THERMAL DIFFUSION SEPARATIONS. Technical Summary Report. Sorensen, J. P.; Willis, M. S.; Stewart, W. E. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Jan 1974. 51p. (MRC-TSR-1358). NTIS $3.75.

The theory of the Clusius-Dickel column in static operation is extended to include eccentric misalignment of the inner cylinder. Variable-property effects are included. An orthogonal expansion method is used, and a computer program is provided for general application of the method. The new theory is useful for determining alignment tolerances in commercial separation columns or in absolute measurements of (α_T). The theory is supported by experiments on separation of gaseous ^{20}Ne from ^{22}Ne. (auth)

26995 DEFLECTION OF ATOMIC BEAMS BY RESONANCE RADIATION USING STIMULATED EMISSION. Nebenzahl, I.; Szöke, A. (Departments of Physics and Chemistry, Tel-Aviv University, Tel-Aviv, Israel). Appl. Phys. Lett. 25: No. 6, 327-329 (15 Sept 1974).

A new method is presented for the deflection of atomic and molecular beams by momentum transfer from resonantly absorbed and reemitted electromagnetic radiation. The method, which uses adiabatic rapid passage by chirped optical pulses, is capable of high energy efficiency. It can be used for isotope separation. (auth)

26996 WHAT PRICE COMMERCIAL ENRICHMENT? Smith, D. Nucl. Eng. Int.; 19: No. 218, 527-584(Jul 1974).

A survey of the U enrichment situation is presented which draws largely on the information given at the Atomic Industrial Forum's international uranium enrichment conference, Reston, Virginia, April 1974. The issues which are discussed include the question of supply and demand, cost of separate work units, new U. S. estimates of future U requirements and comparison with previous forecasts. Contracting conditions of alternative suppliers to the USAEC are compared. The greatest problem concerning the enrichment plants is financial and the role of industrial consortia, utility consortia and government, in the operation of enrichment projects is considered. Various organizations are aiming at the pooling of enrichment activities, to act as a buffer against unforseen variations in U requirements. The status of centrifuge technology in the U. S. is discussed and summaries are given of diffusion and nozzle plants and also ultracentrifuge projects in various countries. (UK)

26997 THE LENS EFFECT OF THE EXTRACTION ELECTRODE APERTURE ON HIGH-INTENSITY ION BEAMS IN ELECTROMAGNETIC ISOTOPE SEPARATORS. Menat, M.; Chavet, I.; Kanter, M. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Nucl. Instrum. Methods; 118: No. 1, 135-140(1 Jun 1974).

The divergent-lens effect of the electrode aperture (slit or hole) on high-intensity ion beams, where the space charge cannot be neglected, is calculated to a first approximation with the help of basic physical laws. Simple relations are derived for the effective lens power resulting from these phenomena and for the location of the final virtual object to be imaged in the collector region. Results are given both for concentric-cylinder (slit) and radially symmetric (hole) configurations. (auth)

Isotopic Power Sources

26998 (DPST-74-128-7) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jul 1974. Contract AT(07-2)-1. 34p. Dep. NTIS $4.75.

Parameters used to fabricate seven lots of PPO shards are listed. PPO pellets MHP-22 to 24 were fabricated with the revised LASL shard specifications. Microprobe analyses of occasionally observed impurity particles in hot-pressed $^{238}PuO_2$ show a potential introduction of stainless steel during processing. Impurity particles of refractory ceramics and steel may have been caused by impurities introduced during processing or from impurities in the feed. The AEC has requested an estimate for a facility at SRP to produce heat sources for the Milliwatt RTG. The elements of the supporting technical program are described. No microstructural damage to dense $^{238}PuO_2$ shards was observed on heating to 1600°C after six months of helium decay. The status of the Plutonium Experimental Facility is described. (auth)

26999 (N-74-17793) MINI-BRAYTON HEAT SOURCE ASSEMBLY DESIGN STUDY. Volume 1. Space Shuttle Mission. Final Report. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). Dec 1973. NAS3-16810. 187p. (NASA-CR-121223(Vol. 1); GESP-7103(Vol. 1)). NTIS $12.50.

Conceptual design definitions of a heat source assembly (HSA) for use in nominal 500 watt electric (W(e)) 1200 W(e) and 2000 W(e) mini-Brayton isotope power systems are reported. The HSA is an independent package which maintains thermal and nuclear control of an isotope-fueled heat source and transfers the thermal energy to a Brayton rotating unit turbine-alternator-compressor power conversion unit. (auth)

Radiation Sources

Refer also to abstracts 26412, 26680, 26705, and 27090.

27000 ACTIVITY DETERMINATION OF EXTRACTS WITH THE USE OF LIQUID SCINTILLATORS. Latal, F. (Inst. for Research, Production, and Use of Radioisotopes, Prague). Radioisotopy; 15: No. 3, 437-456(1974). (In Czech).

A brief review of a method for leak testing of sealed sources is given. Directions for the calibration of the TRI-CARB Packard Instrument Model 2002 are given for the most frequently occurring nuclides. An account of the achieved efficiencies for individual nuclides as a function of the amount of the extract added to the liquid scintillator is given, together with a survey of the optimum amplification for the maximum counting efficiency. (auth)

Design and Fabrication

27001 KRYPTON-85 SOLUTION PREPARATION. Apparatus and Procedures. McLain, M. E.; Meaders, J. C.; McFarland, R. C. (Georgia Inst. of Tech., Atlanta). Int. J. Appl. Radiat. Isotop.; 25: No. 7, 325-328(Jul 1974).

An apparatus is described that was designed and constructed for the safe and efficient preparation and packaging of ^{85}Kr stock solution from which individual tracer solution containers can be filled to be used for reaeration studies. Up to 50 Ci of ^{85}Kr per batch of solution have been prepared by this method and shipment of up to 1000 miles by commercial air freight in accordance with DOT requirements has been carried out without significant loss of ^{85}Kr. (UK)

Industrial Uses

Refer also to abstracts 27023, 27054, 27088, 27089, 27091, and 27098.

27002 (IAEA-R-931-F) CELL COUNT REDUCTION IN SEASONING, PARTICULARLY IN GROUND PAPRIKA BY RADIATION TREATMENT. Part of a Coordinated Programme on the Shelf-Life Extension of Irradiated Fruits and Vegetables. Final Report, 1 October 1970-30 September 1973. Farkas, J. (International Atomic Energy Agency, Vienna (Austria)). Dec 1973. 9p. NTIS.

With the objective of achieving radurization and radicidation of spices and mixed seasonings, a 3-year investigation was undertaken at the Central Food Research Institute, Budapest, Hungary, to study the effects of low-dose radiation treatment on seasonings, with particular reference to ground paprika. Viable cell counts in ground paprika, treated with radiation doses of 0-1600 krad, were determined by the plating method as well as by the dilution technique. Sulphuric acid solutions and various saturated salt concentrations were used to control and to set the equilibrium relative humidity in the samples. Furthermore, investigations relating to the establishment of disinfesting radiation doses for the various developmental stages of Plodia interpunctella were undertaken. To study the effects of various kinds of ionizing radiation in the decontamination of certain seasonings and additives used in the canning and meat industry, seasoning-containing brawn and canned seasoning-containing pork liver paste samples were subjected to different radiation doses. In addition, canned liver paste samples were exposed to various heat treatments with sterilization equivalents of $F_0 = 13.2, 1.47 + 0.14$, resp. Moreover, the effect of different packaging materials and storage temperatures on irradiated paprika was studied. Investigations on finding a method to detect radiation treatment in ground paprika were also pursued. On the basis of these experiments, it appeared that decontamination by ir-

radiation of the seasonings would be technologically feasible. Besides, use of irradiated seasonings would permit heat treatment to be reduced significantly and the quality of the product would be better than that presently available. (INIS)

27003 EFFECT OF IONIZING RADIATIONS ON SOME ORGANOLEPTIC CHARACTERISTICS OF EDIBLE MUSHROOMS. Kovacs, E.; Vas, K. Acta Aliment.; 3: No. 1, 1-17(1973).

Organoleptic characteristics, i.e., color, odor, flavor, and texture, of edible mushrooms (Agaricus bisporus) in various stages of ripeness were examined as a function of exposure to radiation, storage time, storage temperature and humidity (3 to 5°C, 70 to 90% RH; 16°C, 65 to 75% RH). It was found that immediately after irradiation the mushrooms assumed a slight brownish hue which did not change during further storage. (The brown discoloration of untreated mushrooms proceeded in the course of storage.) The color of the irradiated mushrooms changed very little in the course of storage (6th, 11th or 13th day). Other examined properties (odor, flavor, texture) were not affected by irradiation neither immediately upon treatment nor during further storage. Ionizing radiation was found to exert a favorable influence on the organoleptic properties of picked mushrooms and to delay the deterioration of these properties. Radiation treatment preserves the characteristic mushroom odor which is considered an advantage in canning. (Hung. Tech. Abstr.)

27004 EFFECT OF IONIZING RADIATION ON POST-HARVEST RIPENING PROCESSES OF CULTURED MUSHROOMS (AGARICUS BISPORUS) WITH SPECIAL REFERENCE TO THE RATES OF RESPIRATION AND OF ETHYLENE PRODUCTION. Kovacs, E.; Vas, K. Acta Aliment.; 3: No. 1, 19-25(1973).

Recent findings have shown that ionizing radiations considerably prolong the shelf life of edible mushrooms. The physiological effects of irradiation on the respiration and ethylene production of mushrooms were studied. It was found that the respiration intensity of radiation-treated mushrooms stored in cold premises (5 to 8°C, 70 to 90% RH) decreased with increasing exposures to radiation, that the normally low ethylene production of the mushrooms was increased by irradiation, and that the shelf life of mushrooms irradiated with 300 krad can be estimated at 4 to 5 days when stored at room temperature. (Hung. Tech. Abstr.)

27005 METHOD AND APPARATUS FOR DETECTING PARTIALLY-FILLED OR ABSENT CONTAINERS IN A SEALED SHIPPING CARTON. Nelson, L. A. (to Gerber Products Co.). US Patent 3,828,193. 6 Aug 1974. Filed Date 11 Aug 1971. 6p.

A non-destructive method and apparatus for determining the presence of broken or missing containers in a sealed opaque shipping case, including a source of γ-rays directed at the case, means for detecting variations in γ-ray radiation at a fixed point as the case passes between the γ-ray source and the detecting means, and means responsive to the variations for isolating any shipping case found to contain broken or missing containers are discussed. (Official Gazette)

27006 MEASUREMENT OF MASS FLOW RATES OF WATER AND STEAM IN EVAPORATOR TUBES ON OPERATING BOILERS USING RADIOTRACERS. Brown, M. (Central Electricity Generating Board, Harrogate, Eng.). Int. J. Appl. Radiat. Isotop.; 25: No. 7, 289-294(Jul 1974).

A new technique has been used to measure the mass flow rates of steam and water in an evaporator tube on an operating boiler. Sodium-24 was used to label the water phase and ^{41}Ar to label the steam. The technique has permitted individual flow rates to be measured with an accuracy hitherto unobtainable. (auth)

27007 INSECT CONTROL IN WHEAT FLOUR WITH GAMMA IRRADIATION. Tilton, E. W.; Brower, J. H.; Cogburn, R. R. (Stored-Product Insects Research and Development Lab., Savannah, GA). Int. J. Appl. Radiat. Isotop.; 25: No. 7, 301-305 (Jul 1974).

When commercially produced, bleached, and enriched wheat flour was artificially infested with insects, packed in metal cans or multiwall paper bags, and irradiated with ~40 krad in a ^{60}Co γ irradiator, insects of all species were present one month later but in much smaller numbers than in the controls. After 3 to 14 months, no living insects were found in the irradiated flour, and healthy populations were present in the untreated flour. Thus control of insect species in flour can be achieved by doses of ~40 krad, but death of the older stages is not immediate. (auth)

27008 IRRADIATION DEVICE FOR TESTING AND IRRADIATION OF MATERIALS USING RADIOISOTOPES. Nemec, J. Czech Patent 146,920. 28 Feb 1972. 6p. (In Czech).

An irradiation device for the testing and irradiation of materials using radioisotopes is described consisting of a rotary polygon and a radioisotope source container. It is characterized by the fact that the rotary polygon carries on its circumference freely swinging containers for the placement of materials to be irradiated, whose path consists of periodical, firmly linked rotary and translational movements derived from the rotating switching cam mounted on the shaft of the tension chain pulley, from microswitches and switching springs placed in the axis of the radioisotope source container. (INIS)

27009 POSSIBILITY OF PROLONGING THE DURATION OF CONSERVATION OF SAUSAGES BY IRRADIATION. Keskin, S. (Centre d'Etude de l'Energie Nucleaire, Ankara). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 2, 89-97(Jun 1974). (In French).

Microbiological studies were made on the possibility of prolonging the storage time for sausages by irradiation. The sausages, packed in polyethylene, were irradiated at internal doses of 0.2 to 1.0 Mrad and preserved at two different temperatures after irradiation (3 ± 1°C and 8 ± 1°C). Bacteriological and organoleptic examinations were made immediately after irradiation and periodically at 10-day intervals. It was observed that after irradiation the red colors of all the irradiated sausages are paled by the γ radiation and the paleness increases as a function of the dose. It was established that the development of microorganisms and putrefaction in irradiated and non-irradiated sausages were more rapid at 8°C. For this reason it was concluded that it is necessary to keep the sausages at 3°C after irradiation and that the optimum dose is 0.8 Mrad for the preservation of sausages irradiated and packed in polyethylene for a period of 130 days. (tr-auth)

LIFE SCIENCES

Refer also to abstracts 27556 and 27557.

Radiation Effects on Biochemicals

Refer also to abstracts 27033, 27049, and 27197.

27010 (CONF-730907-P1, pp 457-468) COMMON MOLECULAR MECHANISM IN RADIOBIOLOGY: ITS IMPLICATIONS IN RADIOLOGICAL PROTECTION. Chadwick, K. H.; Leenhouts, H. P. (Euratom-ITAL, Wageningen, Netherlands). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The development of a theoretical model is described, which attempts to describe the biological action of ionizing radiation starting from a molecular mechanism through the cellular effects to the effects occurring in animals. The model is based on the action of radiation on the DNA molecule in the cell and it is assumed that radiation induced DNA double strand breaks are the most critical lesions in cellular radiobiology. The molecular mechanism of DNA double strand breakage is described and related to cellular effects such as radiation-induced cell death and radiation-induced mutations. Evidence is presented to show that cell death, mutations, and DNA double strand breaks all have the same dose kinetics. The effects of dose rate and LET on DNA double strand breakage and on cell death and mutation induction are considered and the original equations can be modified to give the form expected at low dose and low dose rate. Using the basic equations a limiting relative biological effectiveness is defined, which is dose and dose rate independent and is particularly relevant in radiological protection. The cellular effects are tentatively related to effects occurring in animals and organs such as animal survival and radiation induced cancer. The theoretical equations are compared with experimental data in the literature. The consequence of the mechanism for the genetic effects of radiation is briefly discussed with regard to the radiation dose kinetics. It is concluded that the model gives dose relationships that are nonlinear but contains a means of extrapolating from high dose, high dose rate results to obtain parameters which could be of importance for radiological protection. It suggests that a basic mechanism may be common to the various radiobiological effects and to all eukaryotic cells and it would thus provide a basis for the extrapolation of results in animals to man. The model also provides a common link between the biochemistry of DNA, the metabolism of the cell, radiobiology, and radiological protection. (auth)

27011 PHOTOREACTIVATION OF SISTER CHROMATID EXCHANGES INDUCED BY ULTRAVIOLET IRRADIATION. Kato, H. (National Inst. of Genetics, Mishima, Shizuoka, Japan). Nature (London); 249; No. 5457, 552-553(7 Jun 1974).

In contrast to the inefficiency of ionizing radiation in the induction of sister chromatid exchanges (SCE), uv light can cause a striking increase in SCE frequency in mammalian chromosomes. It has been shown that in Chinese hamster cells SCE require post-irradiation DNA synthesis and that a single uv irradiation can induce SCE repeatedly for several cell cycles. As pyrimidine dimers constitute the major DNA lesions caused by UV, and as Chinese hamster cells have a poor ability to excise them, the delayed occurrence of SCE appears to be due to unexcised pyrimidine dimers. This possibility was tested using a rat kangaroo cell line having a photoreactivating enzyme to find if the frequency of uv-induced SCE was reduced when cells were post-irradiation treated with visible light. The uv irradiation was at doses ranging from 20 to 80 ergs/mm^2 with an incident dose rate of 5 ergs/mm^2/sec, and the visible light used came from a 20W fluorescent "blue light" bulb. It was found that uv irradiation at 80 ergs/mm^2 caused about a four-fold increase in SCE frequency, but that post exposure to visible light markedly lowered the SCE frequency. The only uv-induced DNA lesion known to be reversible by photoreactivation is pyrimidine dimer, and it is concluded that the lesions leading to the production of SCEs are pyrimidine dimers. There appear to be indications that SCE is closely related to post-replication repair of uv-induced DNA damage. Possible mechanisms are discussed. (UK)

27012 COMPARATIVE STUDIES ON THE SENSITIVITY TO SODIUM HYPOCHLORITE OF GLIADIN AND GLUTENIN FROM IRRADIATED WHEAT. Bancher, E.; Stachelberger, H.; Washuettl, J. (Technische Hochschule, Vienna). Mikrochim. Acta; No. 4, 627-631(Jul 1974). (In German).

A study was made of the effect of ^{60}Co γ-irradiation of the winter wheat "Record" on the gluten proteins gliadin and glutenin isolated from the flour. The experiment consisted of manometric measurement of the quantity of gas released by reaction of the proteins with a sodium hypochlorite solution. At the beginning of the storage period the proteins from the irradiated samples were more reactive than those from the controls, but from the sixth month of storage on, the amount of gas evolved was the same from all samples, within the experimental error. (auth)

27013 RADIATION DAMAGE IN BIOLOGICAL MATERIALS. Parsons, D. F. (Rosewell Park Memorial Inst., Buffalo). pp 482-483 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

It is shown that the feasibility boundaries of electron microscopy must be related to particular biological objects. Chromatic aberration is the limiting aberration. Minimizing radiation damage is considered. (MCG)

27014 SYNTHESIS OF PHOTOREACTIVATING ENZYME IN SYNCHRONOUS AND ASYNCHRONOUS CULTURES OF ESCHERICHIA COLI. Craine, B. L.; Kantor, G. J. (Wright State Univ., Dayton, OH). Mutat. Res.; 24: No. 3, 259-270(Sep 1974).

The technique of flash photolysis was used to study cellular variations in the number of photoreactivating enzyme (PRE) molecules during the cell division cycle of the uv-sensitive E. coli strain B_{s-1}. No variations in the number of PRE molecules per genome were observed throughout the cell division cycle when synchronized cells cultures in either glucose-minimal or succinate-minimal medium were used. This is interpreted to mean that PRE synthesis is continuous throughout the cell cycle for glucose-grown cells, but may stop at the time chromosome replication ceases prior to division, in succinate-grown cells. The effect of growth rate and stage of growth on cellular PRE content in asynchronous cultures was also determined. Variations in the number of PRE per genome were observed for both synchronous and asynchronous cells cultured in different media and occurred in a manner that suggested a dependence on growth rate. PRE per genome increased with generation time. Stationary phase cells from each culture medium (nutrient broth, glucose-minimal, succinate-minimal) had more PRE per genome than did respective log phase cells. It is suggested that PRE synthesis may be controlled by some aspect of chromosome replication. (auth)

Radiation Effects on Cells

Refer also to abstracts 27010, 27087, 27143, 27174, and 27195.

27015 EFFECT OF POST-TREATMENT WITH CAFFEINE ON SURVIVAL AND UV-INDUCED MUTATION FREQUENCIES IN CHINESE HAMSTER AND MOUSE LYMPHOMA CELLS IN VITRO. Fox, M. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Mutat. Res.; 24: No. 2, 187-204(Aug 1974).

The effect of post-treatment with caffeine on the survival of a number of cell lines after uv irradiation has been studied. The mouse lymphoma cell lines P388 and L5178YS were sensitized by caffeine but only after uv doses of 50 erg/mm^2 and above. V79 cells also showed sensitization by caffeine but CHO cells and two cell lines YS and YR derived from Yoshida sarcoma of rats, sensitive and resistant to uv radiation, respectively, showed no effect. P388 and V79 cells were both mutable by uv, and caffeine, when studied at a single expression time (42 to 48 h) and at a single dose level (0.5 *M* and 0.75 *M*, respectively) suppressed the uv-induced mutation frequency in both cell lines. L5178YS cells although sensitized by caffeine showed no increase in frequency of thymidine-resistant (TdR^r) colonies when irradiated with uv. On more detailed examination, caffeine was found to delay the expression of uv-induced mutations in V79 cells, and the delay was dependent on the dose of caffeine used. The effect on expression time was less when caffeine was present 0 to 48 h than when it was present throughout the post-irradiation incubation period. Similar results were obtained in P388 cells. The data are discussed in relation to those of other workers and to the concept that caffeine inhibits an error prone post-replication repair process in mammalian cells. (auth)

27016 HEAVY PARTICLES IN THERAPY. An Application of Track Theory. Katz, R.; Sharma, S. C. (Univ. of Nebraska, Lincoln). Phys. Med. Biol.; 19: No. 4, 413-435(Jul 1974).

The survival, OER and RBE for Hela, leukemia, and kidney cells after irradiation with 14 MeV neutrons, pion beams, and heavy ion beams dispersed by ridge filters were calculated. Simple beam models and the delta-ray theory of cellular survival were used in the calculations which referred to a mixed radiation environment and the potential application of these irradiation systems in radiotherapy. (auth)

27017 EFFECT OF GAMMA IRRADIATION ON CELLS OF ARACHIS HYPOGAEA L. AND DOLICHOS LABLAB L. GROWN IN CULTURE. Batra, A.; Arya, H. C. (Univ. of Rajasthan, Jaipur, India). Indian J. Exp. Biol.; 12: No. 1, 67-71(Jan 1974).

Different doses of gamma radiation (5 to 8000 R) were given to A. hypogaea and D. lablab callus tissues grown on Murashige and Skoog, and Hildebrandt's tobacco high salt media, respectively. Tissues were subcultured within 2 to 3 hr of irradiation and grown on fresh media of the same composition. Cytomorphological studies of these cells revealed no visible manifestation of radiation effects at the lower doses up to 500 R. Higher doses from 1000 to 8000 R caused irregular cell shapes with papillate projections in both the tissues. These projections were more prominent in A. hypogaea than in D. lablab cells. At higher doses, migration of the nucleus to the periphery, deformity of the cells, decreased cytoplasmic movement (as observed under phase contrast microscope) and reduced number and size of cytoplasmic strands were the general effects of irradiation in both the tissues. At 8000 R, coagulation of protoplasmic mass took place. Some of the cultures exposed to 5000 R were green and showed cytomorphological features characteristic of non-irradiated cells. (auth)

27018 MECHANISMS OF INHIBITION OF THE POSTIRRADIATION RECOVERY IN CELLS. II. Inhibition of Unscheduled DNA Synthesis in HeLa Cells After uv-Irradiation By Caffeine and Acriflavine. Zhestyanikov, V. D.; Semenova, E. G.; Volkova, Z. M. (Inst. of Cytology, Leningrad). Tsitologiya; 16: No. 7, 868-873(Jul 1974). (In Russian).

Acriflavine ($5 \cdot 10^{-5}$ to $5 \cdot 10^{-7}$ M) and caffeine ($1 \cdot 10^{-2}$ and $2 \cdot 10^{-3}$ M) affected the ^{3}H-thymidine incorporation in HeLa cells after uv irradiation decreasing the survival of the cells after uv irradiation and inhibiting uv-induced unscheduled DNA synthesis in the asynchronous and synchronized (G_1-phase) culture. Acriflavine inhibited the normal (replicative) DNA synthesis in the HeLa cells after uv light, while caffeine did not affect it. (auth)

27019 MEMBRANE SURFACE PROPERTIES OF RED BLOOD CELLS FROM X-IRRADIATED RATS AS MEASURED BY PARTITION IN TWO-POLYMER AQUEOUS PHASE SYSTEMS. Water, H.; Tung, R.; Krob, E. J.; Swingle, K. F. (Veterans Administration Hospital, Long Beach, CA). Radiat. Res.; 59: No. 3, 614-628(Sep 1974).

Partition of cells in two-polymer aqueous phases can be used to detect and trace differences and changes in certain membrane surface properties as a function of in vivo maturation and aging and in vitro treatments. The countercurrent distribution of rat erythrocytes and bone marrow cells which were x-irradiated (1000 rads) give patterns identical to those previously found with the corresponding normal cells. Membrane changes associated with reticulocyte maturation are observed to proceed normally in irradiated rats (1000 rads). However, ^{59}Fe injection into a rat 30 hr after x-irradiation followed (18 hr later) by countercurrent distribution of peripheral red cells reveals that the youngest reticulocytes are absent from the blood. The label is present only in the oldest reticulocytes and youngest erythrocytes. Cells derived from the bone marrow of in vivo irradiated rats (6 or more hr after irradiation, 1000 rads) contain a large quantity of erythrocytes that have the same surface properties (i.e., partition) as peripheral erythrocytes. Studies indicate that irradiation at the level used has no effect, measurable by this most sensitive means (i.e., partition), on the membrane surface properties of formed cells. Most readily apparent is the marked effect on cell biosynthesis itself. (auth)

27020 MODIFICATION OF RECOVERY FROM POTENTIALLY LETHAL X-RAY DAMAGE IN PLATEAU PHASE CHINESE HAMSTER CELLS. Evans, R. G.; Bagshaw, M. A.; Gordon, L. F.; Kurkjian, S. D.; Hahn, G. M. (Stanford Univ., CA). Radiat. Res.; 59: No. 3, 597-605(Sep 1974).

The survival of density inhibited Chinese hamster cells assayed immediately after 1500 rads (SF_0) was compared to that obtained from cells held for 6 hr at 37°C in their high density condition (SF_s). The ratio of SF_s to SF_0, designated the surviving fraction ratio (SFR) was determined for various post irradiation conditions. If the density inhibited cells were overlaid with full medium following irradiation, the SFR was approximately 4 while in Hanks' BSS the SFR was 15 to 20. The recovery from x-ray damage was inhibited by lowered temperature: the SFRs were 10 and 2 at 25 and 4°C, respectively, compared to 16 at 37°C. This inhibition was almost completely reversible following transfer of the cells from the lower temperatures to 37°C and further incubation. The SFR under full medium (postirradiation) conditions was not significantly modified by the presence of metabolic inhibitors at concentrations nontoxic to at least 70% of the cell population. When the irradiated cells were kept in suspension rather than left in monolayers during the incubation period, the SFR was reduced from 15–20 to 4–5. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 27002, 27009, and 27014.

27021 (CONF-730907-P1, pp 382-387) NEW LOW LEVEL ENVIRONMENTAL RADIATION MONITORING AROUND NUCLEAR FACILITIES; DISCRIMINATING FROM NATURAL RADIATION. Moriuchi, S.; Imai, K.; Miyanaga, I. (Japan Atomic Energy Research Inst., Tokai). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Recently, gaseous effluents from nuclear reactors and other nuclear facilities are controlled in such a low level, that the γ radiation exposure from them amounts less than 10 mrem/yr at the site boundary. Natural γ radiation fluctuates due to the fluctuation of radioactivity in air, the sweeping effect by rain, shielding effect by snow and water content in soil, and other factors. It would be very difficult to measure γ exposure less than a few mrem/yr from gaseous effluents discriminating from such natural background fluctuations even by using high-pressure ionization chambers. For monitoring environmental radiations from nuclear facilities, discriminating the fluctuating natural radiation, a NaI(Tl) scintillation exposure rate meter with flat energy response is used. This equipment consists of a 2 × 2-inch NaI(Tl) scintillator and two separate electronic units, one is an exposure rate meter having a pulse height weighting circuit for flattening the energy response and other a single channel pulse height analyzer, and was tested to see the stability for a long-run operation in the field and to examine discriminating characteristics. Natural radiation has wide energy spectrum distribution up to 2.62 MeV, and changes with time rather uniformly in wide energy range. Therefore, one can measure the environmental radiation from nuclear facilities by detecting total γ radiation in full energy range and natural γ radiation in the higher energy channel separately and taking the differential between them. Results of the test were satisfactory for measuring increases in exposure less than 1 mR/yr of γ radiation from a research reactor under natural fluctuation of background and showed a good stability in a long-run operation in the field. (auth)

27022 (IAEA-R-795-F) EFFECT OF IRRADIATION ON THE MICROECOSYSTEM OF SEWAGE. Part of a Coordinated Programme on the Study and Improvement of Biosphere Resources. Final Report, 1 April 1970–31 May 1972. Ramakrishnan, C. V. (International Atomic Energy Agency, Vienna (Austria)). May 1973. 5p. INIS.

The resources of water are scarce in large parts of the world which in turn affect agriculture and public health. The use of sewage water for irrigation is hindered by its content of pathogens and parasitic organisms endangering the public health safety. The common parasitic and pathogenic organisms in the tropics are primarily represented by amoeba, hookworm, and ringworm, as well as a number of bacteria and viruses. Although chlorination is a relatively inexpensive treatment method, it does not destroy worms and spores efficiently. Moreover, an excess of free residual chlorine seems to inhibit the growth of sewage algae which play essential roles in the sewage purification processes in the oxidation pond. Attempts have been made in this research project to investigate the technical and economic feasibility of using the microbicidal effects of γ irradiation for sewage water processing when applied under properly developed conditions. The research has involved a wide range of studies including the aspects of radiation effects on microorganisms, analytical biochemistry, isolation and identification of the pathogenic organisms content in common domestic sewage and other relevant ecological considerations of the microflora in irradiated sewage. The studies have indicated that γ irradiation of sewage with a dose of 0.1 Mrad facilitates the settling of suspended organic solids without affecting the algae adversely. A dose of 0.05 Mrad γ radiation was found to eliminate more than 90% of the pathogenic organisms used to inoculate the sterile sewage samples in the experiments reported. These studies, subject to further confirmation, indicate that a radiation dose of 0.05 Mrad when given in combination with chlorine should be able to reduce the pathogenic germ numbers of sewage

and sewage waters for their reutilization and recycling. The report also includes the isolation from γ irradiated sewage of a number of bacterial mutants characterized by higher amylase, protease, and cellulase activities. The results have shown a number of interesting features of the sewage microflora with regard to their ecology and radiation responses. While the use of γ irradiation alone for sewage processing seems to prove uneconomical, other alternate possibilities from combining radiation with chlorination as well as through the improvement of microbial biodegradation by selecting appropriate mutants could provide additional methods of choice which might render the process economically feasible and at the same time effective. (INIS)

27023 (IAEA-R-974-F) IRRADIATION OF DEHYDRATED FRUITS (FIGS, PRUNES, RAISINS, ETC.) AT DISINFESTATION DOSES: CHEMICAL AND MICROBIOLOGICAL ASPECTS. Part of a Coordinated Programme on the Shelf-Life Extension of Irradiated Fruits and Vegetables. Final Report, 1 January 1971–30 Apr 1973. Belli-Donini, M. (International Atomic Energy Agency, Vienna (Austria)). Aug 1973. 9p. INIS.

Dehydrated fruits, because of their adequate contents of carbohydrates, mineral salts, and vitamins are considered of high nutritive value. However, the problem of infestation with Ephestia insects gives rise to preservation difficulties during storage. As doses of 300 krad were found sufficient to achieve disinfestation of the product, studies relative to the effect of irradiation on the chemical constituents and microflora of dehydrated figs and prunes were undertaken. To this effect, dehydrated figs and prunes were gamma-irradiated at respective doses of 30, 60, 300, and 600 krad. Assessments for dry weight, total sugars, reducing sugars, vitamins B_1, B_2, β-carotene, as well as the determination of bacterial loads in the irradiated fruits were carried out immediately after irradiation and at periodical intervals during storage. Similar evaluations were run on non-irradiated dehydrated figs and prunes for comparison. The results of the study indicated that radiation treatment of dehydrated figs and prunes for disinfestation against insects of the genus Ephestia would be technically feasible at a dose of 300 krad. At this dose level, no change in the carbohydrate or vitamin content of the fruits was observed. Furthermore, total bacterial counts in irradiated figs were noted to be greatly reduced. (INIS)

27024 (IEA-26) APPLICATION OF RADIOISOTOPES IN THE GAS AND PETROLEUM INDUSTRIES. Castagnet, A. C.; Sanchez, W. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Sep 1973. 38p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $5.00.

A brief description is given of the principal radioisotopic techniques used in the gas and petroleum industries. The applications of these techniques from prospecting to industrialization are outlined. The tracers measurement techniques used are described. The activation of chemical reactions in production of petroleum products is discussed. Radioisotopic techniques for composition analysis are described. The safety and protection measures taken in the use of radioisotopes are discussed. (JSR)

27025 RADIATION-INDUCED MUTATION RATE AND DNA CONTENT IN SCHIZOSACCHAROMYCES POMBE. Nasim, A. (National Research Council of Canada, Ottawa). Mutat. Res.; 24: No. 2, 211-212(Aug 1974).

A remarkable correlation between forward mutation rate per locus per rad and the DNA content of various organisms ranging from bacteria to mice has been reported. This communication presents data from experiments using a forward mutation system in Schizosaccharomyces pombe following exposure to γ rays. The following results were obtained: the increase in mutation frequency with dose was statistically significant and the specific locus mutation rates per locus per rad averaged (based on five different loci) 1.85×10^{-9}. When this value is normalized for DNA per haploid genome of S. pombe, a value of 1.85×10^{-7} is obtained which is very similar to Neurospora and S. cerevisiai. (ERB)

27026 YEASTS AND RADIATION EFFECTS. Ito, T. (Tokyo Univ.). Iden.; 28: No. 3, 72-77(Feb 1974). (In Japanese).

The effect of radiation on living cells was explained from three different actions, reciprocal action with the cell-constituting substances, at molecular level, and cellular level. For the study of yeast cells, it is significant to elucidate the relationship between the complexity of cells and the effect of radiation. Emphasis was laid on the fact that in the eukaryote, the chromosome is usually diploid, and this difference influences the manifestation of the effect of radiation. Analogous points to bacterial cells are injury at molecular level, the presence of light recovery enzymes, and the presence of mutant strains highly sensitive to radiation. In dehydrated yeast cells, thymidine dimers by ultraviolet rays were not formed, and the structure of the DNA showed the same change as that of the extracted DNA. Characteristics of the eukaryotic system of yeast cells were multiple increase, radio-resistant increase, changes in radiation sensitivity in the cell cycle, and the relationship between mitotic recombination and radiosensitivity in diploid strains. Described was the duplicate mechanism, longitudinal and horizontal, of the DNA of eukaryotic cells and the relation to hereditary changes by radiation. Based on these, in yeast cells, the repair mode related to recombination repair is important. Demonstrated with activation energy was the difficulty of reaction of binding of light recovery enzyme with injured DNA in the repair mechanism of radiation injury of yeast cells and E. coli. In the liquid holding recovery of yeast cells in dark recovery, the entire reaction speed is different by about 20 times from the removal process of E. coli, and its factors were discussed. (JA)

27027 DEPENDENCE OF RADIATION SENSITIVITY ON OXYGEN TENSION IN OEDOGONIUM. II. Effect of Temperature and LET. Howard, A.; Gilbert, C. W.; Greene, D. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Radiat Bot.; 14: No. 2, 101-107(Jun 1974).

The value of K (the O_2 concentration at which one-half of the oxygen-dependent radiation sensitivity is expressed) for two radiations of different LET was investigated in vegetative cells of the alga Oedogonium cardiacum. Oxygen concentration in the water surrounding the cells was controlled by gas bubbling before and during irradiation. From D_0 values of survival curves, K for 300 kVp x rays was estimated to be $17.6 \pm 2.0\ \mu Ml^{-1}$. From survival values in air, N_2 and 0.87% O_2, K for 14 MeV neutrons was estimated to be $8.7 \pm 3.8\ \mu Ml^{-1}$. At the same oxygen concentration the cells were more sensitive to x rays at 0 to 1°C than at room temperature by about 12%. The change was the same in hypoxic and aerated conditions so that the oxygen enhancement ratio of 2.9 remained the same. The relation between OER and dissolved oxygen concentration was independent of the temperature. (auth)

27028 GENETIC STUDY OF X-RAY SENSITIVE MUTANTS IN YEAST. Game, J. C.; Mortimer, R. K. (Univ. of California, Berkeley). Mutat. Res.; 24: No. 3, 281-292(Sep 1974).

A set of 64 mutants of Saccharomyces cerevisiae that confer sensitivity to x-ray inactivation were analyzed genetically to determine the number of genetic loci involved. The mode of interaction of various combinations of mutants was also determined. A minimum of 17 genes, when mutant, increase x-ray sensitivity of yeast, primarily by eliminating the resistance of budding haploid cells and by removing the shoulder on the survival curves of diploid cells. Eight mutant loci affect principally x-ray sensitivity while the remaining genes also control sensitivity to ultraviolet. Some of the genes when homozygous block sporulation or result in partial or complete sterility. Examination of the survival responses of multiple-mutant strains indicated a minimum of two pathways in the repair of x-ray damage. A number of the mutants have been mapped and these were found to be dispersed over the genome. (auth)

27029 RADIOSENSITIVITY TO GAMMA RAYS OF SPORES OF A DNA POLYMERASE DEFICIENT MUTANT OF BACILLUS SUBTILIS. Terano, H.; Kadota, H. (Kyoto Univ.). Mutant. Res.; 24: No. 3, 379-381(Sep 1974).

The spores of a mutant strain of B. subtilis which is defective in DNA polymerase I activity were compared with those of its parent strain with respect to the effects of radioresistance on colony-forming ability and the ability to repair the radiation-induced single-strand breaks in DNA. The results indicate that spores of the DNA polymerase I deficient mutant of B. subtilis are more sensitive to γ rays than those of its parent strain. The differences in radiosensitivity seem to be explained by the genetic differences in repairing ability between the strains, particularly in DNA polymerase activity. (ERB)

27030 GENETICS AND BREEDING OF THE ENTOMOPATHOGENIC FUNGUS BEAUVERIA BASSIANA (BALS.) VUILL. IV. Variability of the Virulence Induced by UV-Light. Kirsanova, R. V.; Usenko, L. I. (Inst. of Genetics of Industrial Microorganisms, Moscow). Genetika; 10: No. 7, 97-102(Jul 1974). (In Russian).

The spontaneous and uv-induced variability of the virulence on Drosophila of Beauveria bassiana was studied. The doses used (3034, 9888, and 13,000 erg/mm^2) increased the variability of the virulence and deformed to asymmetry the range of variability. (auth)

27031 STABILITY OF NO. 7B BLOOD PRESERVATIVE DURING ITS PROLONGED STORAGE IN POLY(VINYL CHLORIDE) SACKS FOLLOWING RADIATION STERILIZATION. Manu-

eva, G. N.; Bolotnikova, F. I. Probl. Gematol. Pereliv. Krovi; 18: 60-63(May 1973). (In Russian).

A method of radiation sterilization of No. 7b blood preservative in plastic sacs is described which provides sterility of the preservative and stability of the plastic; sterilization occurs without rupture of sacs, which takes the place of thermal methods of sterilization. (auth)

27032 TISSUE REACTION AFTER IMPLANTATION OF CATGUT STERILIZED BY CONVENTIONAL METHODS AND BY IRRADIATION IN PARENCHYMATOUS ORGANS. Helpap, B.; Staib, I.; Seib, U.; Osswald, J.; Hartung, H. Bruns Beitr. Klin. Chir.; 220: No. 3, 323-333(May 1973).

Tissue tolerance to catgut surgical sutures sterilized with ethylene oxide and by irradiation (^{60}Co) was studied in the muscles, liver, and kidney of rats and rabbits. The time after implantation of catgut was from one day up to 20 days. The results show that catgut is resorbed in the liver and kidney as quickly as in the muscles. The acute-inflammation reaction was stronger in the muscles than in the liver and kidney. The percentage of the cell types in the resorptive granulation tissue (leukocytes, lymphocytes, plasmocytes, histiocytes, and fibroblasts) was similar for all three tissues and for the different catguts. Only plain catgut induced the development of giant cells in the granulation tissue. There were no differences in resorption and tissue reaction of catgut implants after sterilization with ethylene oxide or by irradiation. (auth)

27033 DEGRADATION OF DNA FOLLOWING ULTRAVIOLET IRRADIATION OF ESCHERICHIA COLI K12 MUTANTS LACKING DNA POLYMERASE I AND EXONUCLEASE V. Strike, P.; Emmerson, P. T. (Newcastle upon Tyne Univ. (UK). Dept. of Biochemistry). Mol. Gen. Genet.; 130: No. 1, 39-45(Apr 1974).

5 figs.; 2 tabs.; with refs.

Exonuclease V, the ATP-dependent exonuclease, which is a product of the recB and recC genes, is not responsible for the excessive UV-induced DNA degradation in polA mutants since cells mutant at both polA and recB retain the ability to degrade their DNA after UV irradiation. It is proposed that the excessive degradation in polA mutants could be due to uncontrolled 5′ to 4′ exonuclease activity of the amber fragment of DNA polymerase I. An ATP-independent exonuclease, which appears in recB mutants suppressed by sbcA mutations does not restore the ability of recB mutants to degrade their irradiated DNA. UV induced DNA degradation in E. coli cells made permeable to small molecules requires an ATP dependent, NEM sensitive function which may be an endonuclease that acts early in the repair process. (auth)

Radiation Effects on Plants

Refer also to abstracts 27017, 27023, and 27798.

27034 (IAEA-R-435-F) BREEDING FOR RESISTANCE TO BLOTCH DISEASE (SEPTORIA SPP.) IN WHEAT USING INDUCED MUTATIONS. Part of a Coordinated Programme of Research on Methods of Production and Use of Induced Mutations in Plant Breeding. Final Report, 1 September 1966-15 December 1970. Favret, E. A. (International Atomic Energy Agency, Vienna (Austria)). May 1971. 8p. INIS.

In an experiment to induce mutations for resistance against Septoria in wheat, the M_3 generation was grown under field conditions. However, since natural infection by Septoria was low, selection for resistance was ineffective. Research aiming at development of efficient artificial inoculation methods was continued. Septoria nodorum was cultivated on artificial media to study the influence of nutrients, light and temperature on growth and sporulation. Growth and development were best at 22-24°C and continuous illumination, however strong influences of the nutrient media composition were observed as well. A high nitrogen supply seems to be particularly important. Attempts to transfer resistance against rusts and Septoria from Agropyron trichoforum to bread wheat have reached a promising stage. Lines with resistance to Septoria have been selected, which show however, a considerable amount of chromosomal irregularities. X-ray treatments were made to produce translocations that might lead to cytologically more stable lines with 42 chromosomes. Crosses for resistance to Puccinia graminis tritici and Puccinia recondita have reached the stage of the F_2 generation. (INIS)

27035 CYTOGENETIC ANALYSIS OF THE ANTIMUTAGENIC EFFECT OF α-TOCOPHEROL TO SPONTANEOUS AND RADIATION-INDUCED CHROMOSOME MUTATIONS. Alekperov, U. K.; Akjundova, D. D. (Inst. of Botany, Baku). Genetika; 10: No. 7, 11-17(Jul 1974). (In Russian).

The antimutagenic effect of α-tocopherol at concentrations of 1.10^{-5} to 1.10^{-1} mcC/ml was studied with respect to spontaneous and radiation-induced chromosome mutations in Allium fistulosum L. and Vicia faba L. It is established that at these concentrations α-tocopherol exhibits a significant antimutagenic activity, decreasing the frequency of chromosome mutations more than by 40 to 50%. No changes resulting from the antimutagenic effect of α-tocopherol were observed in the spectrum of structural mutations of chromosomes. (auth)

27036 CHIMERISM IN GENERATIVE TISSUE OF ARABIDOPSIS THALIANA PLANTS AFTER X IRRADIATION OF SEEDS. Grinikh, L. I.; Shevchenko, G. A.; Grigor'eva, G. A.; Draginskaya, L. Ya. (Inst. of Developmental Biology, Moscow). Genetika; 10: No. 7, 18-28(July 1974). (In Russian).

Chimerism of different inflorescences of M_1 plants of Arabidopsis thaliana grown from x-irradiated seeds (50 kR) was investigated. Using Muller's embryo-test, 32.8% mutants were found. Further analysis of all inflorescences revealed that all the mutant plants were chimeric. They were divided in two groups: (1) with chimeric, (2) with non-chimeric generative tissue of the main shoot. The average mutated sector size was constant in inflorescences of different orders both in the main and additional shoots, developed from the axils of rosette leaves, and it comprised 62.0% in the group 1 for the main and 59.0% for additional shoots, and in the group 2 - 100.0% for the main and 51.2% for additional shoots. Percent of chimeric inflorescences on the main shoot decreased with the increase of the order of inflorescences and comprised for apical and lateral order 1 and lateral order 2 inflorescences 100.0; 40.0; and 19.6% respectively. Constant sector size and independence of chimeras of lateral inflorescences of the same order from their succession on the shoot pointed out that no loss of any sector occurred in the course of the formation of lateral shoot meristem, and the selection of mutated and non-mutated tissues between lateral inflorescence took place. The same mutated sector size in the main and additional shoots (developed from the axils of rosette leaves) for the group 1 plants, the slightly less size of the mutated sector in additional shoots for the group 2 plants, and also the fact that a plant was observed which carried non-segregated mutant pods in which identity of mutations in the main and three additional shoots was obvious, enabled to believe that the main and additional shoots in our experiments originated from generative cells of the same initial ones and that initial cells divided prior to the formation of the meristem of the main shoot. (auth)

27037 TYPES AND FREQUENCIES OF CHROMOSOMAL ABERRATIONS INDUCED BY IRRADIATION OF DIFFERENT PARTS OF INTERPHASE IN CREPIS CAPILLARIS. Luchnik, N. V.; Morozov, K. N.; Ovchinnikova, V. G.; Fesenko, E. V. (Inst. of Medical Radiology, Obninsk, USSR). Mutat. Res.; 24: No. 3, 293-306(Sep 1974).

Quantitative and qualitative estimates of chromosomal damage in roots of Crepis capillaris were made in metaphase cells at many time intervals after irradiation with 200 or 400 rad of ^{60}Co gamma rays. The results have confirmed the general pattern described for cells of other organisms, and have revealed in addition the following new facts. (1) The formation of aberrations of chromosome and chromatid type is not determined by the time of chromosome duplication alone. (2) The relative frequencies of different types of discontinuity form peaks with the following time succession: single gaps, chromatid breaks, isolocus breaks. (3) The location of peaks does not depend on the radiation dose, and shows no correlation with the time of synthesis. (4) Irradiation of G_2 induces a significant number of chromosome-type exchanges in Crepis. (5) Higher doses of radiation in G_2 favor the formation of chromatid over chromosome exchanges and of isochromatid breaks over chromosome breaks. A new interpretation of the production of certain types of aberration is discussed. (auth)

27038 RADIATION SENSITIVITY AND MUTABILITY OF AN INDUCED MUTATION IN WHEAT. Valodzin, U. G.; Kartel, M. A.; Lisouskaya, E. I. (Inst. of Genetics and Cytology, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 4, 84-89(1974). (Belorussian).

For investigating the dependence of radiation reactions on an organism genotype, preliminary studies were made on the radiation sensitivity and mutability of the original strain Erektum 106 and the radiation mutant MB-1 obtained in the laboratory by 4 irradiation (20 kR) of seeds of this strain. The mutant is characterized by the presence of vestigial structures, arising within the framework of varietal differences. Radiation doses of 5, 10, 20, and 30 kR were used, and field tests included observation of germination and viability of depression of development of quantitative vestigial structures, and frequency of chromosome aberrations in the first mitosis. Mutability was determined by frequency in the M_2 of seeds with chlorophyll mutations. The results showed an increased sensitivity of the mutant to the action

of radiation. The spectrum of chlorophyll mutations in the mutants was broader than in the original. The rate of spontaneous mutations in the induced mutant was increased. The data indicate that the mutant is a new induced radiation genotype. (tr-auth)

27039 INCREASED MEIOTIC RECOMBINATION BY INCORPORATED TRITIUM. Singer, C. B.; Brock, R. D.; Oram, R. N. (Commonwealth Scientific and Industrial Research Organization, Canberra, Australia). Radiat. Bot.; 14: No. 2, 139-145(Jun 1974).

Tritium applied as ^{3}H-orotic acid to the anthers of tomato during interphase-early prophase of meiosis increased recombination between the marker loci a and hl by approximately 50%. The same amount of tritium applied as ^{3}H-thymidine or ^{3}H-water caused only small, nonsignificant increases. Equal parts of ^{3}H-orotic acid and ^{3}H-thymidine increased recombination by approximately 25%. The ^{3}H-orotic acid and the ^{3}H-thymidine were localized in the RNA and DNA fraction respectively. The ^{3}H-water was not localized in nucleic acids. It is postulated that the ^{3}H-orotic acid is incorporated into the RNA of the synaptonemal complex during prophase of meiosis and increases recombination by localized β-irradiation. (auth)

27040 CHANGES IN THE RATES OF APPARENT PHOTOSYNTHESIS IN 21% AND 1% OXYGEN AND OF DARK RESPIRATION FOLLOWING A SINGLE EXPOSURE OF THREE-YEAR-OLD PINUS STROBUS L. PLANTS TO GAMMA RADIATION. Ursino, D. J.; Moss, A.; Stimac, J. (Brock Univ., St. Catherines, Ont.). Radiat. Bot.; 14: No. 2, 117-125(Jun 1974).

Rates of apparent photosynthesis (in 21% and 1% oxygen) and dark respiration were measured 1 to 21 days following a single exposure of young white pines to doses of gamma radiation ranging from approximately 230 to 7500 rad. At all dose levels, the rates of apparent photosynthesis were reduced. The percent change in the rates of both 0_2 concentrations following irradiation were similar suggesting that the initial response was at the photosystem level. In contrast to photorespiration, which was probably reduced by the radiation, the rate of dark respiration, through unchanged one day after radiation, increased thereafter. The data reaffirmed the sensitivity of the photosynthetic capacity of white pines to ionizing radiation and the differential response of the chloroplast and mitochondrion organelles. (auth)

27041 GENETIC INTERACTION BETWEEN THE TISSUES OF CARNATION PETALS AS PERICLINAL CHIMERAS. Pereau-Leroy, P. (CEN de Cadarache, Saint-Paul-les-Durance, France). Radiat. Bot.; 14: No. 2, 109-116(Jun 1974).

The Jacqueline and Jacky varieties of carnation with orange red-striped or orange flowers are natural mutants of the red-flowered variety William Sim. Gamma irradiation of their cuttings with 5000 R leads to the formation of a considerable proportion of stems with red flowers and with yellow ones, attesting to their structure as periclinal chimeras. In order to investigate this structure, Jacqueline was treated with colchicine, and cyto-chimeras produced whose flowers have remained orange. By irradiation of cuttings 4-2-2, homogeneous tetraploid stems with yellow flowers and diploid branches with red flowers were obtained. Conversely, after irradiation of cuttings 2-4-4, all the diploid branches had yellow flowers and the tetraploid ones, red flowers. Thus the varieties of orange flowers were chimeras whose T_1 alone had mutated for the yellow flower characteristic; however their petal epidermal cells, the only pigmented cells, were orange in color. It is suggested that mesophyll of the petal carrying the red flower genotype, while not pigmented itself, has an influence on the synthesis of pigments in the epidermal cells. This interaction between the genotypes of a chimera is not universal and seems to depend on the mode of action of the genes involved in biochemical syntheses. Thus the variety White Sim, whose T_1 alone carries the white flower mutation, had no pink flowers in spite of T_2 and the corpus having retained the red flower genotype. Carnation petals are simple organs which lend themselves well to biochemical analyses; no doubt they might be used profitably for the study of enzymatic processes linked with the different modes of gene action. (auth)

27042 SOMATIC CROSSING-OVER IN GLYCINE MAX (L.) MERRILL. Differential Response to ^{3}H-Emitted β-Particles and ^{60}Co Emitted γ-rays. Vig, B. K. (Univ. of Nevada, Reno). Radiat. Bot.; 14: No. 2, 127-137(Jun 1974).

Glycine max (soybean) is the only angiosperm thought to exhibit somatic crossing-over. The varieties L65-1237 and T219 have gene combinations Y_{11} Y_{11}, Y_{11} y_{11}, and y_{11} y_{11} resulting in various leaf colors. Heterozygous genotypes may have colored spots on the two simple leaves, some of which may be the result of somatic crossing-over. Seeds treated with ^3H_2O showed an increased spot frequency, but the relative proportions of different spots were unaltered over the concentration range 5 to 10 Ci/ml. Storage of the seeds gave the same effect, presumably by production of an internal mutagen. Seed treatment with gamma radiation (50 to 750 R) also gave an increased spot frequency but with altered incidences of different colors, possibly as a result of increased segmental losses, numerical inequalities, and mutations of the gene Y_{11}. The specific reverse mutation $Y_{11} \rightarrow y_{11}$ would be very rare. The difference between the effects of the two types of radiations may be the result of differences in their relative biological effectiveness. The irradiation procedures did not alter the higher frequency of spots on the upper leaf surfaces, either as a result of the resistance of the spongy mesophyll to applied mutagens or to developmental differences in the two layers. The frequencies of the specific locus (Y_{11}) mutations increased parallel to the frequency of total abnormalities, indicating that chromosomal processes were as vulnerable to the effects of radiations as the processes leading to the production of point mutations. (UK)

27043 DIFFERENTIAL SENSITIVITIES OF INDUCED DWARF RICE MUTANTS TO GIBBERELLIN, FAST NEUTRON, AND GAMMA RADIATIONS. Rao, H. K. S.; Kada, J. (National Inst. of Genetics, Mishima, Shizuoka, Japan). Radiat. Bot.; 14: No. 2, 153-157(Jun 1974).

Sensitivity to radiations and gibberellin were studied in eight established radiation or chemically induced dwarf rice mutants of rice var. Norin-8. Seedling height reduction measured as an index of radiation damage revealed two of the mutants to be more resistant to both gamma and fast neutron irradiation. The radiosensitivity of other mutants was either equal to or greater than that of the parent, Norin-8. The RBE values for 50% seedling height reduction for 14.1 MeV neutrons, however, varied only between 7 and 8. Growth promotion to similar extents by Gibberellin A_3 was observed in five mutants and the parent while this effect was absent in another mutant which was found earlier to be dependent on copper for callus differentiation. There was an inhibitory effect of GA_3 in the remaining two mutants which had been chemically induced and were now found to be radioresistant. (auth)

27044 INFLUENCE OF DIPLONTIC SELECTION ON MICRO-MUTATIONS IN GAMMA-IRRADIATED BARLEY. Mishra, R. K.; Das, K. (Banaras Hindu Univ., India). Radiat. Bot.; 14: No. 2, 69-72(Jun 1974).

A study was undertaken to observe the effect of diplontic selection on some quantitative characters of barley. Seeds of barley variety K_{1-2} were irradiated with 20, 30, and 40 kR of gamma rays. R_3 and subsequent generations were comprised of progenies from the first five and the later formed five tillers of R_1 plants. R_3 and R_4 progenies were grown in a randomized block design. Induced variability for six quantitative traits were characterized considering mean and coefficient of variation in the R_3 and R_4 generations. Results showed that the mean shifted in either direction in R_3 and in the negative direction in R_4. However, the selection basis of the two spike categories did not result in any significant differential mutability of polygenes between the first formed five tillers and the later formed five tillers of R_3 and R_4 generations. (auth)

27045 INDUCED HIGH LYSINE MUTANTS IN BARLEY. Doll, H.; Koefe, B.; Eggum, B. O. (Danish Atomic Energy Commission, Risoe). Radiat. Bot.; 14: No. 2, 73-80(Jun 1974).

Screening of mutagenically treated materials by combined Kjeldahl nitrogen and dye-binding capacity determinations disclosed fourteen barley mutants, which have from a few to about 40% more lysine in the protein and one mutant with 10% less lysine in the protein than the parent variety. Comparisons of six high lysine mutants with the parent variety showed that grain yield and seed size of the mutants are reduced between 10 and 30%. However, the most promising mutant had the lowest reduction in grain yield, and the absolute lysine yield of this mutant was some 30% above that of the parent variety. Feeding tests with rats revealed substantial increases in the biological value of the high lysine mutant protein. Also the net protein utilization was improved but less so because of a somewhat reduced digestibility of the mutant protein. (auth)

27046 GAMMA-RADIATION-INDUCED GENETIC DAMAGE AND GAMETIC STERILITY IN LUFFA CYLINDRICA (LINN) ROEM. Katiyar, R. B.; Roy, S. K. (Banaras Hindu Univ., India). Radiat. Bot.; 14: No. 2, 81-84(Jun 1974).

To study the degree of chromosomal abnormalities and the amount of sterility contributed by either the male or the female gamete, or by both, and their correlation in M_1 plants of Luffa cylindrica grown from dry seeds irradiated at 20, 30, and 40 kR of ^{60}Co gamma radiation, the respective self-pollination effects were followed in control and M_1 plants. Five replications were

done for each crossing. Observations were made on chromosomal abnormalities at meiosis, pollen sterility, seed set per fruit, percentage of seed germination and number of surviving seedlings per fruit at each exposure. Chromosomal abnormalities increased with dose. Both male and female gametes of M_1 plants were found significant in transferring sterility when crossed to a control plant and contributed significantly towards total sterility on selfing at each exposure. Comparison between the two reciprocal crosses showed that the average contribution of M_1 pollen to the total amount of sterility was not significantly different from that of the corresponding egg cell. Both the chromosomal abnormalities and gametic sterility are correlated and directly proportional to the dose of gamma radiation. (auth)

27047 INCREASED VARIABILITY IN THE M_2 OF GAMMA-IRRADIATED MUNG BEANS (PHASEOLUS AUREUS ROXB.). Rajput, M. A. (Nuclear Inst. for Agriculture and Biology, Lyallpur, Pakistan). Radiat. Bot.; 14: No. 2, 85-89(Jun 1974).

Seeds of Phaseolus aureus (cultivar 6601) were treated with gamma rays at dose levels ranging from 10 to 40 kR and a study made of the effects of gamma rays on flowering time, plant height, pods per plant, pod length, grains per pod, 100 grain weight and plant yield. In the M_2 generation, the shifts in the mean values of irradiated material for all the polygenic traits occurred toward the positive or negative direction except for mean pod length, which remained unchanged. However, the coefficient of variability increased in all the radiation treatments for the traits studied. This additional variability, in so far as it is genetic, would provide an opportunity for improvement of mung beans by selection. (auth)

27048 EFFECTS OF SEPARATE AND COMBINED BETA AND GAMMA IRRADIATION OF THE SOYBEAN PLANT. Killion, D. D.; Constantin, M. J. (Comparative Animal Research Lab., Oak Ridge, TN). Radiat. Bot.; 14: No. 2, 91-99(Jun 1974).

Soybean (Glycine max L. Merrill cv. Hill) plants in the unifoliolate leaf stage were subjected to various total doses of ^{90}Y beta and ^{60}Co gamma radiation, separately and in combination, at dose rates of either 8.4 or 17.8 rads/min and grown to maturity under outdoor conditions. Biological effects were evaluated on the basis of survival, height, lateral growth from cotyledonary node, and vegetative and seed yield. Survival and height were dependent on total dose and independent of dose rate and the beta/gamma component of total dose. Survival was slightly affected with total dose, and a dose of 2.8 krads reduced height to approximately 50% of control. Lateral growth and vegetative and seed yield were dependent on total dose, dose rate, and the beta/gamma component of total dose. For lateral growth, especially at 2.4 krads, as the dose rate and beta component of total dose increased, the percent of plants with lateral growth increased. Also, especially at 8.4 rads/min, as the beta component of total dose increased, the length of lateral growth increased. For the 50% reduction level, with the exception of seed yield at 17.8 rads/min where the beta and gamma radiation were equivalent, gamma radiation was approximately 1.2 times more effective than beta radiation for both vegetative and seed yield. (auth)

27049 POST-IRRADIATION TREATMENT OF ROOT TIPS OF VICIA FABA WITH PYRONIN Y. Geard, C. R.; Singh, C. B. (Commonwealth Scientific and Industrial Research Organization, Canberra, Australia). Radiat. Bot.; 14: No. 2, 147-151(Jun 1974).

Pyronin Y was found to slow the passage through the cell cycle of root tip cells of Vicia faba. There was little evidence for any synergistic interaction of pyronin Y with radiation-induced chromosomal damage. This finding emphasizes the necessity of examining aberration frequencies at various times after irradiation and indicates the desirability of determining treatment-response relationships within cells from comparable stages of the cell cycle. (auth)

27050 MODIFICATION OF THE RADIATION EFFECT AT THE AGEING OF SEEDS OF VICIA FABA. Dryanovska, O. A.; Nguen Thi Thuan. (Central Lab. of General Genetics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 6, 859-861(1974).

Studies carried out on Vicia faba exposed to doses of 5 to 10 kR γ radiation showed that the aging of the seeds intensifies the natural mutation and the effect of the radiations; the aging of the seeds is accompanied by the manifestation of a dose dependence with undulating character in the manifestation of the mutations; and the wave dynamics expresses the passage of the potential changes into real mutations at the aging of the seeds. (auth)

27051 INFLUENCE OF DIFFERENT DOSES OF GAMMA RAYS ON CERTAIN TISSUES OF PEA PLANTS. Izvorska, N. D. (Inst. of Plant Physiology, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 3, 399-402(1974).

Isolated tissue cultures were used to follow the reaction to different doses of γ rays (700 R to 2,500 R) by certain differentiated tissues and organs of pea plants. This involved the isolation of cross sections of between 3 and 5 mm from roots in the zone of elongation from the stem, and from a leaf of a five-day plant. Results indicated that the callus tissues obtained from roots, stems, and leaves react differently to irradiation with γ rays. Most sensitive to radiations are the calluses obtained from roots and leaves which react much more strongly both to stimulating and to the inhibiting doses of γ rays, compared with calluses from stems. (CH)

27052 EFFECT OF GAMMA AND UV RADIATION AND KSCN AND LiCl ON THE RHIZOID DIFFERENTIATION IN THE GOLDEN FERN, ONYCHIUM AURATUM KAULF. Singh, V. P. (Banaras Hindu Univ., Varanasi, India). Indian J. Exp. Biol.; 12: No. 1, 63-66(Jan 1974).

Exposure to gamma radiation at 20 kR resulted in elongated protonemal filaments and abnormal increase in the number of rhizoids at lateral positions as compared to the control. The polarity of the germinating spores could be reversed at 40 kR. Higher doses caused reduction in length and number of rhizoids. Shorter exposures to uv (2 or 4 min exposure at 2337 Å) effected swelling and branching of rhizoids. Longer exposures (10 min) proved lethal to germinating spores. KSCN (10^{-1} *M*) also induced swelling of the rhizoids and rather slowed down the protonemal growth. LiCl (10^{-1} *M*) supported cell division but inhibited cell elongation. It inhibited rhizoidal differentiation to very high extent as compared to gamma and uv radiations and KSCN treatment. (auth)

27053 SOME ANATOMICAL FEATURES OF A RADIATION-INDUCED GRAPE VARIEGATA. Sharma, R. L.; Mukherjee, S. K. (Indian Agricultural Research Inst., New Delhi. Div. of Horticulture). Vitis; 12: No. 3, 189-191(Oct 1973).

1 tab.; 7 refs. Part of thesis by Sharma, R. L.

Some anatomical and a few distinguishing morphological features of radiation-induced Pusa Seedless variegata are described. The chlorophyll deficient sectors, which were identical on the two surfaces of the leaves, were usually thinner than the green sectors and thinness was either due to the reduced number of mesophyll layers or smaller cells or both. The yellow coloration of chlorotic sectors seemed to be mainly due to thinness of the sectors and to some extent due to lack of sufficient chlorophyll. (auth)

27054 PROTEOLYTIC ACTIVITY IN FLOUR PREPARED FROM GAMMA-RAY IRRADIATED WHEAT. Bancher, E.; Stachelberger, H.; Washuettl, J. (Technische Hochschule, Vienna (Austria). Inst. fuer Botanik, Technische Mikroskopie und Organische Rohstofflehre). 110: No. 36, 569-570(Sep 1973). (In German).

1 tab.; 9 refs.

The proteolytic activity of flours prepared from irradiated (50 and 500 krad) and non-irradiated "Rekord" winter wheat was determined at monthly intervals over a storage period of one year. In all three series of tests maximal enzymic activity was observed due to the storage, which were noticeable in the 4th month of storage in case of the non-irradiated, and in the 2nd month in case of the irradiated product. After an initial increase of the activity in case of the irradiated samples, the activity values became identical after the 4th month with those of the non-irradiated ones, serving as a control. (auth)

Radiation Effects on Animals

Refer also to abstracts 26482 and 27798.

Man

Refer also to abstracts 26762, 26763, 26776, 26780, 26781, 26783, 26784, 27016, 27219, 27237, 27266, 28578–28582, 28856, and 28861.

27055 (AED-CONF-74-140-008) CHANGES AND NEW FINDINGS IN THE ESTIMATION OF THE GENETIC RADIATION HAZARDS. Ehling, U. H. (Gesellschaft fuer Strahlen-und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Biologie). 1974. 9p. (In German). (CONF-740465-1). INIS.

From German x-ray congress; Baden-Baden, F. R. Germany (25 Apr 1974).

The estimation of the genetic risk of a human population due to a certain radiation exposure is complicated by the different mutability of certain genes. Various theories and trends are displayed as to the establishment of the radiosensitivity of man as far as the induction of mutations is concerned. The experiments for the de-

termination of the so-called doubling dose in mice are not yet completed but the values of 5 different genetic test systems coincide with each other. The elucidation of the normal procedure of the mutagenesis in mammals is performed by means of the specific locus method with which viable recessive mutants can be detected. For clearing the question if these results gained in mice hold also for the other mutation types an experiment was conducted revealing the typical character of specific locus mutation also for dominant mutations in the skeleton of mice. The dose rate and the effect of a fractionated irradiation are of special importance. The results of some experiments with mice are reported. Starting from the assumption that the doubling dose for specific locus mutations is representative for the whole genome, the frequency of various mutation types is the same, the dose rate is <0.8 R/min or irradiation is done with small doses of high intensity and that the extrapolation error for the transference of mammal experiments to mean is about 1.2, the result is that a radiation exposure of the population with 5 rem per 30 years increases the spontaneous mutation rate by 3–10% per generation. (GE)

27056 (CONF-730907-P1) PROCEEDINGS OF THE THIRD INTERNATIONAL CONGRESS OF THE INTERNATIONAL RADIATION PROTECTION ASSOCIATION, WASHINGTON, D. C., SEPTEMBER 9–14, 1973. Snyder, W. S. (ed.). (International Radiation Protection Association, Washington, D. C. (USA)). Feb 1974. 798p. (In several languages). Dep. NTIS $13.60.

Separate abstracts were prepared for 112 of the 120 papers included. Abstracts of seven papers appeared in NSA previously as numbers 28:20135, and 27643; 29:00374, 02629, 10471, and 29791; and 30:06697. (CH)

For abstracts of individual papers see: 26403, 26512, 26764–26773, 26780–26782, 26787, 26797, 26801–26803, 26824, 26825, 26897–26906, 26966, 27010, 27021, 27057–27093, 27151–27157, 27207–27213, 27221–27227, 27234–27236, 27262–27265, 28578–28583, 28598, 28599, 28666, 28682, 28743, and 28861.

27057 (CONF-730907-P1, pp 8-13) RADIATION PERSPECTIVE IN THE UNITED STATES OF AMERICA. Nader, R. (Public Interest Research Group, Washington, DC). Feb 1974.

From 3rd international congress of the International congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Radiation hazards to the U. S. population relevant to the uses of x radiation for dental and medical diagnostic procedures and the postulated hazards from the development of nuclear power plants are discussed in relation to the responsibility of citizens to assure that radiation protection regulations are complied with at the Federal, State, and local level. The need for public knowledge as to the risks, probabilities, and alternatives to exposure to low dose ionizing radiations is emphasized. (CH)

27058 (CONF-730907-P1, pp 14-27) PERSPECTIVES ON RADIATION RISKS. Lapp, R. E. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Data on the sources and radiation dose to which the population of the USA will be exposed during the 30-year period 1970 to 2000 are reviewed. The 30-year dose, calculated in terms of man-rems, is estimated as 1,000 for natural background radioactivity, 500 for medical diagnostic procedures, 36 for domestic jet travel, 34 for weapons test fallout, and 0.45 for routine nuclear effluents. The radiation dose to which the population in the vicinity of a nuclear power plant would be exposed in the event of an accident was calculated assuming various meteorological and other variables, as from 0.1 to 1. It is pointed out that power reactors have numerous built-in safety devices for the prevention of the release of radioactivity to the environment. The environmental and economic alternatives of fossil-fueled power plants are compared with those of nuclear power plants. (CH)

27059 (CONF-730907-P1, pp 28-36) PRESENTATION OF U.S.A. NATIONAL ACADEMY OF SCIENCES REPORT ON THE EFFECTS ON POPULATIONS OF EXPOSURE TO LOW LEVELS OF IONIZING RADIATION (BEIR REPORT). Part I. General Review and Implications. Comar, C. L. (Cornell Univ., Ithaca, NY). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Data, assumptions, and numerical risk estimates are presented for the genetic and somatic effects of low levels of exposure to ionizing radiations. It is calculated that exposure of the entire U.S. population to 170 mrem/year would cause at equilibrium (after many generations) between 1100 and 27,000 incidences per year of serious genetic disabilities. In the opinion of the Committee, the same exposure could cause from roughly 3000 to 15,000 cancer deaths annually based on the assumptions used including linearity and with no correction for dose-rate. The uncertainties and bases for these estimates are reviewed. Interpretations are presented in regard to effects on growth and development and on the environment (on organisms other than man). Future major contributions to radiation exposure of the population will continue to be natural background and medical applications. Medical radiation exposure can and should be reduced considerably without any deprivation of benefits. Radiation exposure to the U. S. population from the developing nuclear power industry can be kept at about 1% of natural background and the exposure of any individual kept to a small fraction of background provided that the technology operates as planned. It is suggested that radiation protection standards not be set on an arbitrary basis such as related to background levels, but rather should be established in terms of minimal exposures required to fill society's needs. Hopefully, it will be possible to make meaningful risk-benefit assessments, then to make cost-effectiveness assessemnts so that logical decisions can be made as to the worth of any given effort to reduce the risk, and finally to choose among the alternate options taking into account a comparison of the biological and environmental costs. (CH)

27060 (CONF-730907-P1, pp 37-42) PRESENTATION OF U.S.A. NATIONAL ACADEMY OF SCIENCES REPORT ON THE EFFECTS ON POPULATIONS OF EXPOSURE TO LOW LEVELS OF IONIZING RADIATION (BEIR REPORT). Part II. Genetic Effects. Crow, J. F. (Univ. of Wisconsin, Madison). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Information for assessing the magnitude of the human genetic risk from radiation still comes almost entirely from nonhuman sources, mainly the mouse. It is recommended that estimates for low dosages be made on the assumption of a linear relationship between the effects at the lowest doses where reliable measurements exist and the effect at zero dose. This was chosen as a plausible assumption for some effects (mutation and chromosome breakage) and as a conservative procedure for others (nondisjunction and chromosome loss). Four bases for risk estimation for human populations, in order of reliability are: the risk relative to natural background radiation; the risk relative to specific genetic conditions; the risk relative to current incidence of serious disabilities; and the risk in terms of overall ill health. (auth)

27061 (CONF-730907-P1, pp 43-50) PRESENTATION OF U.S.A. NATIONAL ACADEMY OF SCIENCES REPORT ON THE EFFECTS ON POPULATIONS OF EXPOSURE TO LOW LEVELS OF IONIZING RADIATION. Part III. Somatic Effects. Upton, A. C. (State Univ. of New York, Stony Brook). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Data are reviewed on the effects of low-dose ionizing radiation that are manifest in exposed individuals (i.e., somatic effects) as contrasted to effects that are manifest in subsequent generations (i.e., genetic, or inherited, effects). In general, the acute effects of irradiation are not considered, since these occur only at dose levels well above protection standards. With few exceptions, the somatic effects of interest manifest themselves only after an interval of years or decades following irradiation and are not detectable except in a statistical sense. In any given individual, a particular effect cannot be attributed conclusively to radiation, as opposed to some other cause, and the smaller the dose, the less the likelihood of radiation being the cause. Because no somatic effects causing significant disease or mortality are known to be induced by ionizing radiation at dose rates approaching natural background, the risks of such effects at these dose rates can be estimated only by extrapolation from observations at higher radiation levels, based on assumptions about the relevant dose-effect relationships, the mechanisms through which the effects are produced, and the susceptibility of the populations at risk. (auth)

27062 (CONF-730907-P1, pp 51-63) BIOLOGICAL EFFECTS AND EXPOSURE STANDARDS FOR NON-IONIZING ELECTRO-

MAGNETIC ENERGIES. Michaelson, S. M. (Univ. of Rochester, NY). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

During the last quarter century there has been a marked development and increased utilization of equipment and devices for military, industrial, consumer use, and medical applications that emit a large variety of nonionizing radiant (NIR) energies; these include ultraviolet, infrared, visible light, microwaves, and radiofrequency. Because of the biological consequences of these energies, the Radiation Control for Health and Safety Act of 1968 (PL-90-602) and the Occupational Safety and Health Act of 1970 (PL-91-596) (OSHA) were enacted to protect the general public as well as the worker. For the general population and those persons exposed or with potential for exposure to these energies, personnel exposure guidelines and product emission standards have been promulgated for some of these energies. Personnel protection guides or exposure standards are usually those established by the American National Standards Institute (ANSI), American Conference of Governmental Industrial Hygienists (ACGIH), or Department of Defense. Some industrial organizations have standards of their own which may be modifications of the national standards. Legislation for personnel exposure and product emission levels for NIR is covered under the Occupational Safety and Health Act of 1970 and the Radiation Control for Health and Safety Act of 1968, respectively. It is important that distinction be carefully made between product emission standards and personnel exposure standards and how they relate to potential injury. A proper perspective and realistic assessment of the biomedical effects of these radiant energies is essential so that the individual or general public will not be unduly exposed nor will research, development and beneficial utilization of these energies be hampered or restricted. (auth)

27063 (CONF-730907-P1, pp 64-75) PROGRAM ON NONIONIZING RADIATION PROTECTION OF THE WORLD HEALTH ORGANIZATION REGIONAL OFFICE FOR EUROPE. Suess, M. J. (WHO Regional Office for Europe, Copenhagen). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Increased and wider attention is being paid at present to a relatively new physical hazard, namely, non-ionizing radiation (NIR), arising from devices using ultraviolet radiation, infrared radiation, visible light, microwave radiation, and radiowave radiation. To promote the study of the health effects from NIR the WHO Regional Office for Europe has developed, within its long-term program on environmental pollution control, a sector programme on NIR with activities extending to the year 1979. The mode of action for the control of NIR and the program's priorities are based on the recommendations of a Working Group convened in November 1971. (auth)

27064 (CONF-730907-P1, pp 76-78) PITFALLS IN THE ASSESSMENT OF MICROWAVE RADIATION AS A HAZARD. Carpenter, R. L.; Ferri, E. S.; Hagan, G. J. (Northeastern Radiological Health Lab., Winchester, MA). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The extent to which microwave radiation can constitute a health hazard is a question amenable to laboratory investigation, but the investigator must constantly be on guard against pitfalls peculiar to the investigation of this problem. Among them are: the reliability of power density measuring devices; near field and far field differences in field patterns and in perturbations of the microwave field by the experimental animal itself or by accessory supports or restrainers; whole body heating as a factor influencing results; determination of the relative roles of power density and duration of exposure as dose factors; and limitations on extrapolation to man of results from animal experiments. Attempts to define and to limit these problems are described and illustrated. (auth)

27065 (CONF-730907-P1, pp 79-84) CONTROL AND USE OF LASERS IN N. Y. S. INDUSTRY. Bradley, F. J.; Roberto, S. N. (N.Y.S. Dept. of Labor, New York). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sept 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

To ensure that the benefits of laser radiation will be reaped with little human eye or skin damage, New York State has promulgated Industrial Code Rule 50, to regulate the industrial use of lasers in the State. The Code Rule is generally a performance-type Code but some specification type regulations for certain types of lasers and certain laser working conditions are incorporated. The Code Rule separates lasers into three categories based on their emission characteristics. These are exempt, low intensity, and high intensity lasers. There is an additional classification of the low and high intensity categories into fixed and mobile lasers. The control measures specified in Industrial Code Rule 50 and the industrial use of lasers in the State are discussed in detail. (auth)

27066 (CONF-730907-P1, pp 91-95) PUBLIC HEALTH AND CONTROL OF NON-IONIZING RADIATION IN JAPAN. Iida, H.; Koshijima, T. (National Inst. of Radiological Sciences, Chiba, Japan). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Some effective measures against exposure to laser radiation are reported and the general situation in Japan concerning the protection of people against non-ionizing radiations is described. Studies made on the possible protective measures against the harmful effect of laser radiation, particularly on the eye and skin, revealed that the following three methods are effective against He–Ne laser radiation: absorption by cellophane sheet, absorption by filter, and reflection by non-metallic multilayer film. A number of studies on biological effect of microwave radiation and laser radiation have been conducted in Japan. There are, however, no regulations on the permissible level of these radiations such as those set forth against ionizing radiations on the human body. Recently, home microwave ovens are pervading rapidly. In view of these situations, the Research Committee on Biological Effect of Non-ionizing Radiation from Home Use Instruments was organized in the Ministry of Health and Welfare. Currently, regulations are applied to the manufacturers of these devices by the Ordinance of Ministry of International Trade and Industry. (auth)

27067 (CONF-730907-P1, pp 96-99) PROGRESS IN THE REDUCTION OF MICROWAVE EXPOSURE FROM MICROWAVE OVENS USED IN COMMERCIAL FOOD VENDING OPERATIONS. Wukasch, M. C.; Thiel, J. F. (Texas State Dept. of Health, Austin). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

During the past two years microwave ovens used in commercial food vending operations were surveyed in cooperation with State participating Local Health Departments and Districts in Texas. These surveys have shown that there is a correlation between general sanitation and maintenance with leakage of microwave radiation. Additionally, since October 6, 1971, the effective date of the microwave oven manufacturing standard (developed under the Radiation Control for Health and Safety Act of 1968, PL 90-602), significant reduction in the percentages of leaking ovens has been noted for ovens manufactured after the effective date. (auth)

27068 (CONF-730907-P1, pp 417-428) MALIGNANCY RISK TO HUMANS FROM TOTAL BODY γ-RAY IRRADIATION. Mays, C. W.; Lloyd, R. D. (Univ. of Utah, Salt Lake City). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Based on data from the A-bomb survivors and radiobiological studies on the dose-rate effect, estimates were made of the cumulative deaths from induced malignancies in a natural population of 1,000,000 persons of mixed ages each receiving a total body dose of 1 rad from γ rays. (auth)

27069 (CONF-730907-P1, pp 429-438) RISK OF NEW CANCER IN WOMEN RADIATED FOR BREAST CANCER. Sagan, L. A. (Palo Alto Medical Clinic, CA); Linden, G. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Using the records of the California Tumor Registry, the appearance of new cancers was studied among women treated with radiation for cancer of the breast. Comparison was made with cases treated with surgery only. Results do not demonstrate any excess new cancers in the radiation treated group that can be attributed to radiation therapy. (auth)

27070 (CONF-730907-P1, pp 448-456) THEORY OF RADIATION RISK BASED ON MICRODOSIMETRY. Caldwell, R. D. (Univ. of Pittsburgh). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Applications of microdosimetry to a theory of radiation risk are discussed. Many recent radiobiological experiments show that the relative biological effect (RBE) between two different radiations increases as the dose decreases. The historically developed quantities of radiation dosimetry, the absorbed dose and the dose equivalent fail to account for this phenomenon. Also, because the absorbed dose is an averaged quantity, it provides no physical basis for other than linear extrapolation of biological data to the small radiation exposures encountered in radiation protection. Microdosimetry suggests that a consistent theory of radiation risk cannot be linear for all radiations. Several models which fit the distributions of microdosimetry to biological data are possible. Because none of them can be linear, it is necessary to process the individual datum of a microdosimetric distribution in order to produce an index of risk. As a demonstration of the feasibility of the procedure, a Rossi-type tissue equivalent proportional counter was interconnected with a PDP-8I computer and exposed to several different types of radiation. The results show that single-valued indices of radiation risk can be directly measured and, thus, one of the hurdles to the application of microdosimetry to radiation protection appears to be solvable. (auth)

27071 (CONF-730907-P1, pp 475-480) EXPERIENCE IN USING CLINICAL DATA FOR ESTABLISHING THE MAXIMUM ADMISSIBLE LEVELS OF OCCUPATIONAL IRRADIATION. Gus'kova, A. K.; Denisova, E. A.; L'vovskaya, E. N.; Kirsanova, G. I.; Gribova, I. A. (Inst. of Hygiene and Occupational Disease, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Observation of biological indices of radiation in personnel working with high energy accelerators is described. Irradiation doses accumulated during 10 to 15 years totaled 10 to 100 rad. Radiation injuries have not been observed. Clinical dates have proved the correctness of the present established maximum permissible doses of professional irradiation for these groups of workers. (auth)

27072 (CONF-730907-P1, pp 481-484) EARLY HEMATOLOGICAL DETECTION OF THE EFFECTS OF LOW DOSES OF IONIZING RADIATION IN PROFESSIONALLY OR MEDICINALLY EXPOSED PERSONS. Predmerszky, T.; Geszti, O.; Elod, I.; Lovanyi, I. (Frederic Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

For early detection of the effects of exposure to low doses of ionizing radiation in professionally or medically exposed persons, a method called x-ray resistance of the erythrocytes was used. The hemoglobin level of blood plasma was found to be elevated following professional exposure as well as after diagnostic x-ray procedures, therapeutic x-irradiation, and internally applied therapic doses of radioactive isotopes. This elevation was attributed to increased erythrocyte membrane permeability. This was proved by in vitro irradiation of the blood of persons exposed in vivo to low x-ray doses. The decreased x-ray resistance of erythrocytes was found to be dose-dependent. This method was used to demonstrate the immediate effects of very low doses on the human blood. It may be found valuable in radiation protection. (auth)

27073 (CONF-730907-P1, pp 485-490) PHYSIOLOGICAL INVESTIGATIONS OF THE CENTRAL NERVOUS AND CARDIOVASCULAR SYSTEMS IN PERSONS SUBJECTED TO LONG-TERM OCCUPATIONAL IRRADIATION OVER A PERIOD OF YEARS. Sel'tser, V. K.; Gamper, V. V.; Katsnel'son, G. M.; Loseva, N. V.; Stepanov, A. I. (Inst. of Radiation Hygiene, Leningrad). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A group of 625 men and women subjected to mild doses of occupational radiation exposure (less than 0,3 MPD) for a period over 10 years was tested. Modern methods of physiological reactions and mathematical analyses were applied. No marked functional changes in central nervous and cardiovascular systems were revealed as compared with a control group. (auth)

27074 (CONF-730907-P1, pp 491-494) TRIAL EVALUATION OF THE LONG-TERM SURVEY OF DEATH CAUSES IN THE POPULATION LIVING NEAR RADIATION-RICH HOT SPRING. Maeda, K. (Tokyo Univ.); Abe, S.; Kurokawa, Y.; Minagawa, Y. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

An attempt was made to distinguish the effect of long-term exposure to very low dose rate ionizing radiation by applying a type of retrospective cohort analysis on the population living adjacent to a hot spring rich in radium and radon emanation. Randomly sampled households were interviewed and available data was obtained on causes of death of the family members over three generation. Death cases collected were tabulated according to sex, and compared with that of a control population sample. No difference could be found between the sample and control populations in this investigation. The detailed explanation of the cohort type analysis which was used in this study, Regional Cohort Analysis, was presented, and the feasibility of its application for the evaluation of the effect of long term and low dose exposure to agents such as ionizing radiation was discussed. (auth)

27075 (CONF-730907-P1, pp 495-500) X-RAY EFFECTS ON THE EMBRYO AND FETUS: A REVIEW OF EXPERIMENTAL FINDINGS. Rugh, R.; Leach, W. (Bureau of Radiological Health, Rockville, MD). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Concerns for protection of the fetus from possible effects of ionizing radiation can be justified on the basis of results from abundant mammalian experiments which deal with radiation teratogenesis during embryonic and fetal pre-natal development. Experimental results relative to teratogenesis indicate that early stages of development may be more sensitive to radiation than later stages of development. Animal data on radiation teratogenesis thus supports concerns for radiation protection during early pregnancy. Doses of 25 rads to the fetus during organogenesis are associated with teratogenesis. During early embryonic development teratogenesis has been observed after doses of 10 rad or less to the fetus. Some human diagnostic x-ray procedures exist, which deliver doses of radiation associated with teratogenesis, when such doses are administered to fetal animals at appropriate periods of development. (auth)

27076 (CONF-730907-P1, pp 501-505) STUDY OF THE ADRENAL FUNCTION IN SUBJECTS WITH LONG-TERM LOW LEVEL OCCUPATIONAL EXPOSURE TO IONIZING RADIATIONS. Popscu, H. I.; Lancrajan, I. (Inst. of Hygiene and Public Health, Bucharest). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A study of 24 hr urine elimination of 17-hydroxycorticosteroids (17-OH) by Poster-Silber's method was carried out in 115 men (mean age 40 years) with long-term low level occupational exposure to ionizing radiation (mean duration 11 years). The exposure during the last 5 years did not exceed the maximum allowed doses. A statistical significant decrease of 17-OH eliminations suggesting a mild adrenal insufficiency was revealed in the exposed subjects as compared with the controls. In 10 subjects whose 17-Oh levels were low, the ACTH Gel test was normal, suggesting that this mild adrenal insufficiency is due to an insufficient pituitary secretion. The determination of 17-OH levels after more than 3 months interruption of exposure in a few subjects showed increased values in all. In subjects in whom the determination of 17-OH elimination

was repeated after a lapse of 2 years of continuous occupational exposure, a decrease of values as compared with the previous levels was noted. The results suggest that the follow-up of 17-OH elimination in subjects occupationally exposed to ionizing radiations may be an objective criterion both for the appraisal of a syndrome induced by occupational exposure to ionizing radiations and for the assessment of the effects of temporary interruption of exposure. (auth)

27077 (CONF-730907-P1, pp 506-514) OCCUPATIONAL EXPOSURE TO X RAYS IN POLAND: PROBABILISTIC EXTRAPOLATION TO LIFE-TIME DOSES. Jankowski, J.; Liniecki, J.; Krych, B. (Inst. of Occupational Medicine, Lodz, Poland). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Individuals occupational exposed to x rays in Poland have been monitored since 1966, embracing about 15 thousand persons. The percentage of those monitored who did not reveal exposures above 0.4 R per annum has been declining steadily over the last six years. Extrapolating from data obtained over the last 6 years, the percentage of the employed who are likely to exceed 20 or 50 R over a period of 40 years was calculated. For the former value this probability varied between 0.7 and 4.0 percent for the total population. Probability to exceed 50 R of life-time exposure for total population varied between 0 and 1.5 percent. (auth)

27078 (CONF-730907-P1, pp 528-531) IONIZING RADIATION EXPOSURE RECORDS FOR INDIVIDUALS. Cook, C. S. (Univ. of Texas, El Paso). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Even though many people have expressed alarm over possible effects of the ever-increasing amounts of ionizing radiations in our environment, no records exist from which the cumulative dose for any individual adult in the United States can be tabulated. Rather than stop the construction of new nuclear power stations and limit the use of other radiation sources, such as for medical purposes, simply because we are not sure of the effects, it is time that we determine the nature and magnitude of the effects in such a way that they can be correlated with accurate measurements of radiation dose. Suggestions are made as to how a record-keeping system can be established, without undue involvement of the general populace and with a minimum of monetary cost. (auth)

27079 (CONF-730907-P1, pp 544-549) OCCUPATIONAL EXPOSURE TO IONIZING RADIATION IN IRAQ. Abbas, M. S. (Ministry of Health, Baghdad). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The external exposures of radiation workers in the Republic of Iraq are checked by requiring the workers to wear film badges. Data obtained in 1972 on the yearly exposures of persons at medical services in comparison to persons engaged in research and in industrial radiation work are available. The external radiation exposures received by more than 897 individuals during 1972 are compared with those for the period 1962 to 1971. (auth)

27080 (CONF-730709-P1, pp 591-602) RADIATION AND MAN (1973 SIEVERT LECTURE). Lindell, B. (National Inst. of Radiation Protection, Stockholm). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

It is pointed out that radiation safety problems have been dealt with in a special way and with more concentrated efforts than any other occupational or environmental risk. An internationally applied set of dose limits developed by the ICRP has been used for almost forty years and guarantees that no harmful acute effects will result from the normal uses of radiation. Risks of radioinduced cancer and hereditary defects have been assessed quantitatively during the past twenty years and the possibility of such risks resulting from exposure to very small doses of radiation has been used as the basis for radioprotective measures, although there is no proof that these risks really exist. Data are presented on the radiation doses received by the human population from natural radioactivity, medical uses of radiation including radioisotopes, fallout from nuclear tests, occupational exposure including radon in mines, and the radiation dose from environmental contamination anticipated from the operation of nuclear paper plants to the year 2000. Variations in the radiation exposure of the human population are pointed out. It is suggested that the annual radiation dose commitment be used as the basis for radiation protection standards rather than the annual dose and that the product of the population dose commitment and the risk coefficient be called the harm commitment and that any practice that results in radiation exposures should be subjected to a risk-benefit assessment. If the possible risk is acceptable, the practice should still not be acceptable until it has been shown by a cost-benefit assessment that the resulting exposure is so low that further dose reductions will not bring about a benefit which justifies the effort. (CH)

27081 (CONF-730907-P1, pp 648-653) STUDY OF SPATIAL DISTRIBUTION OF TISSUE DOSES WITH THE AID OF A PHANTOM-MANNEQUIN. Smiennyi, L. N.; Litvinova, E. G.; Khotsev, A. V. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In order to study in detail the radiation environment in a field of complex configuration, the procedure of computing doses in critical organs was developed that takes into consideration real body shapes. A phantom-mannequin having the dimensions of a standard man was manufactured from a tissue-equivalent material. The results of computations of doses in critical organs due to a solar flare with magnetic rigidity of 100 Mv and a flux of 10^{10} protons/cm^2 are presented. Data are included on the doses and fluxes measured in the phantom-mannequin aboard an automatic interplanetary station and an Earth artificial satellite. (auth)

27082 (CONF-730907-P1, pp 659-670) DOSE CALCULATIONS IN EXTERNAL EXPOSURE TO INERT GASES. Schaeffer, R. (Electricite de France, Paris). Feb 1974. (In French).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

For purposes of calculating the radiation dose to man from external exposure to inert gases, since the range of β rays is limited, it is necessary, for each point (P) at a depth (h) in the organism, to define the air volume within which the β rays, which are able to reach the point P, are emitted. In this way the dose rate is calculated for monoenergetic radiations and its variation is plotted against h in a graphic form. This graph points out that the attenuation is relatively important for the low energies at the level of the epidermal basal layer and always very strong at the level of the lens; the gonads and the blood-forming organs are never reached. The graph is applied to the β-ray spectrum of the main inert gases released by nuclear plants (^{41}A, ^{85}Kr, ^{87}Kr, ^{133}Xe, and ^{135}Xe), and the dose rates of the γ rays are added in order to get the values of the maximum permissible concentration (MPC) in air. It is concluded that the most MPC values used till now could be greatly increased. (auth)

27083 (CONF-730907-P1, pp 677-682) DETERMINATION OF ABSORBED ENERGY FOR VARIOUS TYPES OF MEDICAL IRRADIATIONS. Bozoky, L. (Central Inst. for Oncology, Budapest); Feher, I. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

LiF thermoluminescent powder (TLD) was suspended in paraffin alkyl chloride (PAC) paste and this modulable dosimeter was used to simulate tumors of different shapes in order to evaluate the dose absorbed by the tumor in different types of radiotherapeutical treatment under similar in-vivo conditions. The results for the following types of treatment are reported: x-ray beam therapy with Chaoul-machine, interstitial irradiation with radium needles, gynaecological intracavitary irradiation with ^{60}Co γ applicator, extracorporal β irradiation with ^{90}Sr source, γ beam therapy with ^{60}Co source, Bremsstrahlung and electron irradiations with a 25 MeV betatron. In case of homogeneous radiation field the yields of ionization chambers and the TLD-PAC dosimeters are in good agreement. The TLD-PAC technique was found to be particularly useful for the evaluation of the absorbed energy in anatomical formations which are difficult to follow-up by cal-

culation and its application is thought to be of special importance in the case of inhomogeneous radiation fields. (auth)

27084 (CONF-730907-P1, pp 683-687) BETA DOSE FROM CUTANEOUS CONTAMINATION. Unnikrishnan, K.; Hukkoo, R. K.; Bhati, S.; Somasundaram, S. (Bhabha Atomic Research Centre, Bombay). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Determination of the β dose to the basal layer of the skin from surface contaminants was carried out using the latest available data on the dose distribution around point β sources. The calculations were performed for the thin planar source model and take into account the effect of air tissue interface on the dose rate. As the average depth of the basal layer may vary from 4 to 40 mg/cm^2 depending on the body site, the variation of dose rate in this layer is discussed. For use in the estimation of maximum permissible skin contamination from a mixture of β emitters, an attempt was made to provide an empirical formula for the dose rate at a depth of 7 mg/cm^2 (the average value suggested by the ICRP) as a function of β energy. (auth)

27085 (CONF-730907-P1, pp 688-693) CALCULATION OF SURFACE DOSE AND INTERNAL ORGAN DOSE FOR HUMAN EXPOSURE TO WEAPON NEUTRONS. Facey, R. A. (Defence Research Establishment, Ottawa). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A method is described for calculating internal organ dose for humans by computer. Any type of neutron spectrum may be used for input. The method is illustrated by the use of a typical neutron energy angular distribution prepared for civil defense purposes. (auth)

27086 (CONF-730907-P1, pp 700-706) EVALUATION OF PERSONNEL EXPOSURES IN A HIGH-ENERGY HIGH-INTENSITY BETA-GAMMA FIELD. O'Neal, B. L. (Sandia Labs., Albuquerque, NM). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A high-energy, high-intensity $\beta-\gamma$ radiation field occurred in experimental areas of a tunnel complex at the NTS. The β-to-γ dose rate ratio in free air was as high as 28 to 1 (83 rad/hr vs 3 R/hr) and the β particle maximum energy was 3.5 MeV. Evaluation and recovery of experiments resulted in personnel radiation doses approaching the AEC guidelines. The methods described here were used in evaluating the radiation field and determining an estimate of the relative dose to the skin, gonads, and lens of the eye as measured by both thermoluminescent dosimeters (TLD) and film badges. In addition, problems not normally associated with mixed-field, $\beta-\gamma$ dosimetry are discussed. (auth)

27087 (CONF-730907-P1, pp 707-712) DOSE, DOSE EQUIVALENT, EFFECTIVE DOSE, AND CELL SURVIVAL FROM NEGATIVE PIONS. Wright, H. A.; Hamm, R. N.; Turner, J. E. (Oak Ridge National Lab., TN). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Much interest has been shown recently in the use of negative pions for cancer radiotherapy. Several facilities are being constructed that will provide pion beams of sufficient intensity for radiotherapy and clinical trials are planned. Calculations are now being made to provide necessary information for the radiotherapist to plan the treatment of a tumor patient and also for the health physicist in insuring the protection of the patient as well as those working in the vicinity. Monte Carlo computer codes were developed, which take into account all of the relevant physical processes involved as pions penetrate tissue, e.g., inelastic nuclear interactions and the transport of all secondary particles produced, multiple coulomb scattering, range straggling, etc. Good agreement was obtained between the results of these calculations and experimental measurements of absorbed dose. The codes can provide detailed information about the energy and spatial distributions of each type of primary and secondary particle throughout the phantom and also the LET distribution of the energy deposited. In this investigation these codes were used to calculate the spatial distributions of absorbed dose and to study the effects of applying various types of weighting factors to the components of dose. The ICRP recommended quality factors have been applied as functions of LET to determine the spatial distribution of dose equivalent. Experimental RBE values for cell survival have been applied as functions of LET to determine the spatial distribution of the effective dose. The cell survival model of Katz has also been applied for estimating cell survival of human T-1 cells. The results of these various weighting schemes are discussed. (auth)

27088 (CONF-730907-P1, pp 749-759) INDUSTRIAL RADIATION INCIDENTS IN THE UNITED KINGDOM. Burgess, C. D.; Weatherley, E. G. (Dept. of Employment, London). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Certain categories of radiation accidents, incidents, and excessive radiation exposures in the United Kingdom are reportable to HM Factory Inspectorate. The method of analyzing reports of excessive radiation doses is described. The analysis includes the processes and locations associated with these reports, the magnitude of the radiation doses received, and the age groups of the exposed persons. Causes are divided into management errors, operator errors, and equipment failure. The analysis shows that industrial radiography on engineering construction sites is the process which produces most excessive radiation exposures. Unsuitable equipment and inadequate supervision and training of radiographers are found to be the main causes of excessive exposures. (auth)

27089 (CONF-730907-P1, pp 760-768) INVESTIGATION AND RECONSTRUCTION OF A SEVERE RADIATION INJURY TO AN INDUSTRIAL RADIOGRAPHER IN SCOTLAND. Harrison, N. T. (National Radiological Protection Board, Glasgow); Escott, P. C.; Dolphin, G. W.; Purrott, R. J.; Alexander, J. L.; Halnan, K. E. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A severe radiation injury received by a young industrial radiographer concerned with pipeline radiography is described. The reconstructions carried out to explain the incident are discussed together with the calculations made to predict the radiation doses at the site of the injury and the effective whole-body dose. These results are compared to the clinical estimates of the radiation dose profiles at the injury and the estimates of radiation dose made by reference to the film badge worn by the worker and to the chromosome aberrations detected in the lymphocytes obtained in a blood sample. The injury was observed on the upper left area of chest wall adjacent to the left nipple, involving a circular area of skin about 100 mm diameter extending in depth 30 to 40 mm to ribs and even heart muscle. The worker associated this injury with an exposure to an open industrial radiography source housing containing a 25 curie ^{192}Ir γ source during a short car journey with the container open on the adjacent front seat and directed towards him. Evidence is presented to discount totally this explanation and the possible alternatives derived from consideration of the clinical estimates of the radiation dose profile are discussed in detail. The radiation doses at the site of the injury were thought to be up to about 20,000 rads. A brief description is included of the medical treatment given. (auth)

27090 (CONF-730907-P1, pp 769-772) LARGE RADIATION EXPOSURE. Bhushan, V. (Safdarjang Hospital, New Delhi). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A case of large inadvertent radiation exposure to a person concerned with the replacement of a decayed ^{60}Co γ source by a new source in a teletherapy unit is described. An estimated exposure of 800 rads was received by the person while pushing the source in the source head of the unit with the hand in the vicinity of the source itself. The case history is discussed. (auth)

27091 (CONF-730907-P1, pp 773-782) CLINICAL COURSE AND DOSIMETRY OF ACUTE HAND INJURIES TO INDUSTRIAL RADIOGRAPHERS FROM MULTICURIE SEALED GAMMA

SOURCES. Saenger, E. L. (Univ. of Cincinnati); Kereiakes, J. G.; Wald, N.; Thoma, G. E. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In the past several years there have been a number of incidents in which industrial radiographers have received severe radiation injuries to the fingers from inadvertent contact with sealed γ sources of such nuclides as ^{192}Ir and ^{60}Co. These injuries are characterized by an initial severe reaction progressing from erythema and edema to bulla formations at sites of contact with relatively little reaction at distances of 1 to 3 cm from the point of contact. Pain is relatively little in the absence of infection. There is often spontaneous resolution of the lesion over a period of 6 to 8 weeks. Plastic surgical repair depends on the severity of the lesion. Dosimetric measurements and calculations indicate that doses at the surface are in the kilo R range per Ci and at 1 cm are 0.1 to 0.01 of the surface doses. The unusually high surface dose is due in part to electroproduction in the capsule wall. The γ absorption in tissue is 5 to 10% per cm. The inverse square law is the principal factor accounting for the relative lack of effect below 2 cm. (auth)

27092 (CONF-730907-P1, pp 783-790) EVALUATION AND DOSIMETRY OF ACCIDENTAL EXPOSURES TO AN X-RAY ANALYSIS BEAM. Leith, I. S.; Cornelius, W. A. (Australian Radiation Lab., Melbourne). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Accidental exposure of two research workers to an x-ray analysis beam during two days resulted in large area burns to the arms and chest. The dosimetry performed was later corroborated by the clinical findings. (auth)

27093 (CONF-730907-P1, pp 791-796) FACTS, FABLES, AND FOLLIES IN MEDICAL RADIOLOGY. Chamberlain, R. H. (Univ. of Pennsylvania, Philadelphia). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The value of diagnostic radiography in medical practice is discussed and illustrated by the statement that in the USA and other countries where facilities are available, experienced clinicians agree that from one-third to one-half of all important decisions regarding the care of individual patients are based on radiological studies. Applications of developments in physics, electronics, and engineering to the production and control of x-ray beams and to the improvement of methods of obtaining images of human structures have resulted in the reduction of the radiation dose to which patients are exposed. It is emphasized that medical radiology is the only legitimate situation in which human beings are purposefully exposed to ionizing radiation and that the yield of benefits for patients cannot be measured by any simplified criterion. (CH)

27094 (CONF-730907-P2) PROCEEDINGS OF THE THIRD INTERNATIONAL CONGRESS OF THE INTERNATIONAL RADIATION PROTECTION ASSOCIATION, WASHINGTON, D. C., SEPTEMBER 9-14, 1973. Snyder, W. S. (ed.). (International Radiation Protection Association, Washington, D. C. (USA)). Feb 1974. 677p. (In Several Languages). Dep. NTIS $13.60.

Separate abstracts were prepared for 96 of the 100 papers presented in these proceedings. The other four papers were abstracted in volume 29 of NSA as abstract numbers 10477, 12758, 18658, and 26177. (ERB)

For abstracts of individual papers see: 26449, 26733, 26758, 26783, 26793, 26804, 26840-26854, 26907-26909, 26921, 26967, 27095-27123, 27214-27217, 27228, 27237-27254, 27266-27273, 27585, 28649, 28713, 28845, 28846, 28851, and 28856-28859.

27095 (CONF-730907-P2, pp 810-813) SPECIAL PROBLEMS IN RADIATION SAFETY AND SANITARY-DOSIMETRIC MONITORING WHEN WORKING WITH TRANSPLUTONIUM ELEMENTS. Egorova, M. S.; Kopaev, V. V.; Korzhov, L. N.; Parkhomenko, G. M.; Sarychev, V. A. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The factors of radiation exposure at operations with transplutonium elements are in quantitative dependence on the physicochemical properties, the time of target irradiation in the reactors, and the degree of their purification from the fragment fission products. The doses of external and internal irradiation were estimated. (auth)

27096 (CONF-730907-P2, pp 814-823) ENSURING RADIATION SAFETY WHEN USING LARGE ISOTOPIC SOURCES OF IONIZING RADIATIONS FOR BRINGING ABOUT RADIATION PROCESSES. Chistov, E. D.; Larichev, A. V.; Terman, A. V.; Zaraeev, O. M. (Karpov Physicochemical Inst., USSR). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Results of an investigation series for ensuring personnel radiation safety when bringing about various radiation processes are presented. The investigations include: studying radiation penetration regularities in large isotopic plants shielding structures such as labyrinths, technological channels etc. with design formulas; studying environment contamination mechanisms formation using the design formulae which allows to prognosticate the forseen wastes amount. Analysis of the accidents occurring during large isotopic plants operation and proper procedures developed to prevent their occurrence are given. The All-Union standards and methodical rules regulating radiation safety conditions in design, construction, and operation of large radiation apparatus are considered. The many-years experience showed that the observance of the standards developed by the authors reduces and in a number of cases completely excludes the possibility of the personnel overexposure, the environment and irradiated products contamination. (auth)

27097 (CONF-730907-P2, pp 824-829) ESTIMATING THE EFFECT OF THE ABSORBED PHASE OF CONTAMINATION OF PROTECTIVE COATINGS AND MEANS FOR INDIVIDUAL SHIELDING FOR RADIATION CONDITIONS IN WORKROOMS. Kononvitch, A. L. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A method is given for accounting dependence of radioactive contamination hazard on the function type of its distribution in the depth of material. The method is based on describing time dependence of distribution functions by Green's operators. The proposed procedure is simple enough and can be used by the personnel of dosimetric service without special mathematical training. (auth)

27098 (CONF-730907-P2, pp 830-834) ENSURING RADIATION SAFETY WHEN USING INSTRUMENTS WITH RADIOISOTOPIC RADIATION SOURCES. Vershinin, N. V.; Bodrova, D. A.; Volkovitskaya, V. V.; Lyarskii, P. P.; Moiseitsev, P. I. Feb 1974. (In Russian).

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Measures for prevention and current sanitary control in providing radiation security using radioisotopic instruments are given. The demands are indicated to the sources of radiation from instrument and their comparison with the doses of radiation. (auth)

27099 (CONF-730907-P2, pp 835-840) HEALTH PHYSICS AND OPERATIONAL EXPERIENCES IN A TREATMENT AND PACKAGING FACILITY FOR SOLID AND SEMI-SOLID WASTES AT E.I.R. Schwammberger, O.; Brunner, H. (Eidgenoessiches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Solid or semi-solid wastes have either to be stored for long periods or to be disposed by dumping into the ocean or enclosure into suitable geological formations. Each case requires an appropriate treatment and packaging of the wastes. Despite the relatively low specific activities there exist considerable radiation hazards for the operating personnel due to incorporation risks. At EIR Würen-

lingen a waste treatment facility was built that reduces such hazards to acceptable levels. The main installation is a large combination of steel boxes, well ventilated and held at reduced pressure. Operations that can be carried out include sorting of wastes, compression of loose wastes or drums, dismantling or reduction to small pieces, solidification of sludges with cement, casting of concrete mantles and covers etc. All direct contacts between personnel and radioactive material are avoided. Either the men work from outside the box with gloves or remotely operated hydraulic tools or machines, or they work inside the box with respiratory protection or in ventilated plastic suits. An incinerator plant under construction will bring further volume reduction of burnable waste, even for α activities. Experiences reported show that radioactive wastes of low or medium specific activity can be treated and packed according to any requirements without hazards for the operating personnel, the surrounding population or the environments of the treatment facility or the storage sites. (auth)

27100 (CONF-730907-P2, pp 846-851) RADIOLOGICAL SAFETY EXPERIENCE IN HANDLING AND FABRICATION OF PLUTONIUM FUEL ELEMENTS. Janardhanan, S.; Krishnamurthi, T. N.; Soman, S. D. (Bhabha Atomic Research Centre, Bombay). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The problems and experience gained in radiological safety during PuO_2 fuel fabrication for "Purnima" reactor are discussed in this paper. Safety aspects in design, construction and commissioning of metallurgical facilities and glove boxes, measures for contamination control, air, area, and criticality monitoring instrumentation and their calibration are dealt with. Radiological health data are summarized to reflect the adequacy of precautionary provisions followed in fuel fabrication work. Evolution of the methods for related safety problems like assessing neutron emission from PuO_2 fuel pins and Pu in solid wastes are outlined. (auth)

27101 (CONF-730907-P2, pp 882-888) EYE EXPOSURE FROM THORIATED OPTICAL GLASS. McMillan, R. C.; Horne, S. A. (Army Mobility Equipment Research and Development Center, Fort Belvoir, VA). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

During a routine radiation survey of equipment with some optical components the Health Physicist was surprised to find a large reading on an ionization survey instrument. Significant radiation was also observed on a beta-gamma instrument. The source of the radiation was identified as thorium in high quality optical glass. Thorium is added to the glass, in amounts up to 30% by weight, to provide improved optical properties. Similar results may be obtained by using other heavy elements. Thorium is carried as an impurity with some of these elements and the thorium concentration may be greater than 0.05% by weight. Since the glass is used in an eyepiece, the amount of exposure to the eye should be investigated. The beta-gamma exposure rate was determined by thermoluminescent dosimetry (TLD). The measured exposure rate was 1 mRem/hr averaged for 123 hours exposure at the surface of a lens which contained 18% thorium by weight. A computer model for the emission of alphas from the glass, the absorption in air and the final absorption in surface layers of the eye provides a technique for examining the amount of exposure at different depths below the surface of the eye. The results of the model will be compared with experimental results from alpha spectroscopy. Although the alpha particles come from only a small surface layer of the glass, the absorbed dose rate at the surface of the eye may be 50 to 1000 times greater from alpha than from beta-gamma radiation. The size of the lens, and the eye to lens distance determine the number and energy distribution of the alpha particles reaching the eye. To reduce exposure to the eye, thin non-thoriated glass shields were inserted between the lens and the eye. The results of TLD and alpha counting with and without the shielding showed a complete removal of the alphas. (auth)

27102 (CONF-730907-P2, pp 912-919) NEW DATA CONCERNING THE SAFETY OF MINERS IN URANIUM MINES. Pradel, J.; Zettwoog, P.; Madelaine, G.; Francois, Y. (Commissariat a l'Energie Atomique, Paris). Feb 1974. (In French).

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Reports are made, on the one hand, on the first results obtained regarding the action of radon and its elements in an experimental uranium mine at La Crouzille and, on the other hand, on the prospective use of a new portable individual dosimeter proportionate to the exposure of uranium miners to radon éléments. (auth)

27103 (CONF-730907-P2, pp 1017-1021) AS LOW AS PRACTICABLE RADIATION DOSE IN THEORY AND PRACTICE. Whipple, G. H. (Univ. of Michigan, Ann Arbor). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The ICRP introduced the phrase "as low as practicable" into the language of radiation protection some years ago. Recently the U. S. Atomic Energy Commission has proposed to elevate "as low as practicable" to a regulatory standard with numerical limits. This proposal has the effect of reducing the ICRP limit for public exposure by a factor of 100. Such a reduction in an environmental quality standard is probably unique in the field of public health. The justification offered for setting a legal, numerical limit to "as low as practicable" is that if it can be done, it must be done. (auth)

27104 (CONF-730907-P2, pp 1022-1034) RADIATION DANGER TO THE POPULATION DURING OPERATION OF ATOMIC POWER STATIONS IN THE USSR. Gusev, N. G. (Inst. of Biophysics, Moscow); Belyaev, V. A.; Zykova, A. S.; Marei, A. N.; Kuzhetsova, G. A.; Baranov, M. A.; Gunyakov, G. A. Feb 1974. (In Russian).

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The report considers some problems of radiation safety of a population due to airborn releases from the atomic power station. The basic national standards for radioactive releases (actual or predicted) from a PWR APS are given. The problem of the possible scope of the accident of APS which may cause an environmental emergency radiation dose and the problem of the population doses are discussed. (auth)

27105 (CONF-730907-P2, pp 1054-1059) INDIVIDUAL RISK, COLLECTIVE DAMAGE, AND NUCLEAR POWER PLANTS. Delpla, M. (EDF, Paris). Feb 1974. (In French).

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The way that leads from an individual risk to the theoretical collective damage in the matter of irradiation by nuclear power plants is specified. People's reactions towards nuclear power plants are considered. The necessity of defining concepts precisely and of giving them denominations that cause no anxiety is stated. (auth)

27106 (CONF-730907-P2, pp 1072-1077) VADOSCA: A SIMPLE CODE FOR THE EVALUATION OF POPULATION EXPOSURE DUE TO RADIOACTIVE DISCHARGES. Bramati, L.; Marzullo, T.; Rosa, I.; Zara, G. (ENEL, Rome). Feb. 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The code consists of two parts, one for liquid discharges (VADOSCA-LD) and one for gaseous discharges (VADOSCA-GAS), and it incorporates the transfer parameters of twenty-four radioisotopes in the case of liquid discharges, and of twenty radioisotopes in the case of gaseous discharges. It allows the evaluation of the concentrations of the various isotopes in all the compartments of the critical paths outlined in the ICRP Publication No. 7, and the evaluation of the annual doses for five critical organs (whole body, G. I. tract, thyroid, bones, lung) for the various critical groups of population, on the basis of environmental parameters, such as the time of residence in a certain area, diet, type of activity, hydrological regimen, irrigation methods, and meteorological conditions. Although extremely simple, the code allows rapid performance of all the evaluations required to define the amount of radioactivity that can be released and the associated exposures. (auth)

27107 (CONF-730907-P2, pp 1078-1084) NATIONWIDE EVALUATION OF DIAGNOSTIC X-RAY TRENDS: NEXT ORGAN DOSE INDEX SYSTEM. Lubenau, J. O. (Northeastern Radiological Health Lab., Winchester, MA); Hardin, C. M.; Shaver, J. W.; Leggett, I. P. Jr.; Seabron, L. Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The impact of efforts by government agencies to minimize and control unnecessary patient exposure in medical x ray has been difficult to assess. A Task Force of State and Bureau of Radiological Health representatives, created in 1971, has applied the "standard man" concept as a method of evaluating the impact of government control efforts on medical x-ray exposure. A limited number of randomly selected medical x-ray facilities are visited. The operator of an x-ray unit is requested to set the technique factors for a selected examination of a patient whose anthropometric characteristics have been standardized. Exposure data is collected using standardized procedures and equipment. Organ Dose Index values are generated for selected critical organs. By eliminating patient size variation, the wide range of exposure technique factors currently employed in medical radiography has become readily apparent, together with the wide range of gonad doses encountered by a standard patient. It is expected that these can be correlated with governmental agency activities in radiological health and can be modified by their efforts. The methodology of the NEXT Organ Dose Index System is simple. Fifty local, State and Federal radiological health programs in the United States are participating or planning to participate in the system which began operation in October, 1972. Some results of the first nine months of its operation are presented. The system appears to be far more efficient in assessing the impact of governmental program efforts in medical x ray than previously used methods. It avoids the complexity and cost of population exposure studies but can relate program impact in terms of patient exposure and dose. (auth)

27108 (CONF-730907-P2, pp 1085-1090) GENETICALLY SIGNIFICANT DOSE DUE TO MEDICAL X-RAY EXAMINATIONS IN THE NETHERLANDS. Koen, J. A.; Weber, J. (Interuniversitair Reactor Instituut, Delft, Netherlands). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Recent in situ measurements of the gonadal doses of 2500 male patients in seven Dutch hospitals make a reappraisal of the genetically significant dose (GSD) due to x-ray examinations in the Netherlands possible. It was found that the gonadal doses of nearly all examination types in all hospitals form a log normal distribution with a standard deviation of the same order of magnitude as the mean doses. The mean doses differ largely between the hospitals. Measurements in many hospitals will be necessary to obtain a reliable national mean dose for each examination type. The number of examinations for each type varies appreciably per district and needs careful consideration. The child expectancy, which did change drastically during the last 4 years, did not influence the GSD. (auth)

27109 (CONF-730907-P2, pp 1091-1095) EVALUATION OF DIAGNOSTIC X-RAY CONTRIBUTION TO THE ANNUAL GENETICALLY SIGNIFICANT DOSE EQUIVALENT OF TAIWAN URBAN POPULATION. Weng, P. S. (National Tsing Hua Univ., Hsinchu, Taiwan); Huang, C. Y. Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Thermoluminescent dosimeters (LiF-teflon discs) were distributed to clinics and hospitals using x-rays for diagnostic purposes in Hsinchu which is a medium size city of Taiwan with a total population of 213,735. The dosimeters were placed inside a small pocket stitched on a piece of cloth. Before irradiation the patient was covered with this cloth of which the location of the pocket was adjusted to be against the gonadal region of patient's body. The detailed record of the irradiation conditions and the status of patients were provided by the clinics and hospitals concerned. Dosimeters were replaced and read in a one-month interval. Based on the formula given by the United Nations Scientific Committee of the Effects of Atomic Radiation the annual genetically significant dose equivalent was calculated with proper corrections for gonad dose of both sexes. Since one-half of Taiwan population is living in the cities nowadays, and surveys of medical radiation sources in Taiwan have been carried out twice since 1970, the annual genetically significant dose equivalent calculated for Hsinchu is extended to Taiwan urban population. It shows that the annual genetically significant dose equivalent of Taiwan urban population was in the range of 3 to 4 mrem in 1972. (auth)

27110 (CONF-730907-P2, pp 1096-1102) ROLE OF THE HEALTH PHYSICIST IN REDUCING MEDICAL RADIATION EXPOSURE. Gross, R. E.; Marks, M. E.; Audet, M. F.; Benson, J. S. (Bureau of Radiological Health, Rockville, MD). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Medical use of x ray continues to be the greatest manmade source of exposure to the United States population, in spite of substantial improvements in equipment and technique. Reduction of this exposure is possible through training and motivation of allied health professionals. In addition to proposed x-ray equipment standards and current upgrading of technologist proficiency criteria, increased involvement of health physicists is needed. This paper examines the role of health physicists in the health care environment, stressing their potential for effecting exposure reduction through close working relationships with allied health professionals. (auth)

27111 (CONF-730907-P2, pp 1103-1108) DENTAL TECHNIQUE NORMALIZATION: DEVELOPMENT AND PILOT TEST (OF RADIATION EXPOSURE DURING RADIOGRAPHY). Travis, K. L. (Northeastern Radiological Health Lab., Winchester, MA); Stanton, J. R.; Hickey, J. E.; Burnett, B. M. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A two-phase program designed to help control excessive radiation exposure in dental radiography is described and the results of a two-state pilot test presented. The first phase is a data collection system for measurement of radiation exposure from dental x-ray machines and the identification of machines producing excessive exposures. It was found that 54% of the machines surveyed have outputs within "acceptable" exposure limits. Personal in-office visits to the other 46% constitute the second phase of the program. The cause of the excessive exposure was identified and proper radiographic techniques were presented. The result was a reduction of 80.4% in the average exposure at end of cone (mR/film). (auth)

27112 (CONF-730907-P2, pp 1109-1114) .NASHVILLE DENTAL X-RAY STUDY. Johnson, O. N. (Bureau of Radiological Health, Rockville, MD); Crabtree, C. L.; Gibbs, S. J. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In January of 1972, personnel from the Bureau of Radiological Health, U. S. Public Health Service and members of the Department of Radiology, Vanderbilt University, met with representatives of the Nashville, Tennessee Dental Society to discuss dental radiological health practices. When comparing data from the 1964 and 1970 National X-ray Exposure Studies (XES) it was pointed out that the use of slow and intermediate speed dental film decreased substantially, yet the average incident skin exposure remained disproportionately high. In 1964 about half of the dentists were using the slow and intermediate film (speed group A, B and C) and 50% were using fast film (speed group D). In 1970 only 20% of the dentists used slow or intermediate film while 80% were using the fast film. However, the mean incident skin exposure in 1964 was 1,138 mR, whereas in 1970 it was 910 mR, a decrease of only 20%. In 1972, 72 dental facilities in Nashville were visited. It was determined that 95% of the offices were using speed group D dental film. The average incident skin exposure for all 72 facilities was found to be only 542 mR. (ERB)

27113 (CONF-730907-P2, pp 1115-1120) ABSORBED DOSE TO SELECTED INTERNAL ORGANS FROM TYPICAL DIAGNOSTIC EXPOSURES. Poston, J. W.; Warner, G. G. (Oak Ridge National Lab., TN). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Estimates of dose to internal organs from exposure to diagnostic x-ray beams are usually based on measurements of the entrance and exit dose and/or the use of depth dose curves for homogeneous media. Results of a series of Monte Carlo calculations, which mock-up typical diagnostic x-ray procedures

are given. Results are presented for 22 internal organs as well as red and yellow bone marrow for two typical procedures. The calculations employ measured x-ray spectra from 45 kVp, 1-mm Al to 105 kVp, 2-mm Al and are for a field size of 14" × 17". In addition, depth dose profiles in various sections of the heterogeneous phantom are presented for each x-ray beam. (auth)

27114 (CONF-730907-P2, pp 1121-1126) HANDY DEVICE FOR PROTECTION OF THE TESTICLES IN X-RAY EXAMINATIONS. Lindholmer, E.; Berg, O. (Bispebjerg Hospital, Copenhagen). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The Picker lead plastic gonad capsule was modified by mounting leaf springs in the two ducts along its opening slit, thus making it "selfsupporting" and able to adjust itself to the scrotum so that the testicles are covered as completely as possible. Results are given of an investigation of the practical applicability and the shielding effect of the new device. It is demonstrated that the shielding effect of the modified Picker lead plastic gonad capsule is as good as that of the common two-piece lead capsule device. From a practical point of view it is far better, because it is easily applied and causes the patient no discomfort. (auth)

27115 (CONF-730907-P2, pp 1133-1138) MEDICAL RADIATION PROTECTION IN THE EASTERN MEDITERRANEAN REGION. Gomez-Crespo, G.; Ernborg, D. R. E. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Six hundred and fifty diagnostic X ray installations, representing over 50 percent of the existing ones, were surveyed in sixteen countries of the Middle East in 1969/70. A number of technical and human deficiencies were observed. Sixty-five percent of the x-ray units surveyed lacked one or more of the following radiological safety features: adequate filtration; beam no larger than needed to cover the x-ray film; adequate operators' protection; and adequate protection of neighbors and all other personnel. The measures taken to tackle these problems will be described. (auth)

27116 (CONF-730907-P2, pp 1139-1143) SOURCES OF UNNECESSARY IRRADIATION DURING FLUOROSCOPY. Racoveanu, N. T.; Modoran, G.; Suma, S. (Inst. of Hygiene and Public Health, Bucharest). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The 644 gastrointestinal and 731 chest fluoroscopies performed by 6 radiologists were investigated concerning: the duration in time, the area exposed, magnitude of exposure in x-ray beam, the gonadal and bone marrow dose. The patient exposure was found to depend on: 1. mean time duration of the examination, which varied for the six different radiologists, from simple to double (from 169 to 259 sec. for gastroduodenal fluoroscopy, 48 to 80 sec. for intestinal, and 11 to 62 sec. for chest fluoroscopies); 2. quality and exposure rate of primary beam (the exposure rate ranged from 3 to 12 R/min); 3. area exposed during fluoroscopy (cross-section of primary beam varied from 26 to 230 cm^2 for gastroduodenal, from 38 to 383 cm^2 for intestinal and from 47 to 490 cm^2 for chest fluoroscopy; 4. the value dose area product proved to be the most interesting parameter, variations between 420 and 3160 R cm^2 for gastroduodenal, 124 to 2091 R cm^2 for intestinal and 100 to 473 R cm^2 for chest fluoroscopies were recorded, the corresponding integrated dose values were from 3.5 to 26.8 kg. rad for gastroduodenal, from 4.0 to 16.6 kg. rad for intestinal and from 0.8 to 4.0 kg. rad for chest fluoroscopies. The diagnostic information being practically the same, the variations of the operational parameters encountered to the six investigated radiologists, evince the existence of at least three sources of unnecessary irradiation: 1. the use of a too large beam (large surface and integrated dose); 2. the dose rate of primary beam too high; 3. too long time of irradiation; this situation may be related to the knowledge level of the radiologist. (auth)

27117 (CONF-730907-P2, pp 1144-1149) MEDICAL IRRADIATION OF THE POPULATION IN ROMANIA DURING 1970. Racoveanu, N. T.; Diaconescu, C.; Modoran, G.; Vasilescu-Fulea, C.; Plavosin, P.; Milu, C. G. (Inst. of Hygiene and Public Health, Bucharest). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

X-ray examinations increased in Romania between 1953 to 1970 from 429 to 1,012 per 103 inhabitants, photofluorographies (54 to 452) and radiographies (37 to 238) increasing while radioscopies remained at the same level (338 and 322). Age groups 16 to 30 and over 31 years are the most x-rayed averaging 1.22 examinations/inhab./year. Males are predominately investigated at all ages and the most frequent examinations concern the chest, G. I. tract, upper and lower members, vertebral column, pelvis, and teeth. For 1970 the genetically significant dose and the mean bone marrow dose were calculated and the values obtained were 28.5 and 382 mrad, respectively. Radiographies of the abdominal and lumbar regions in females had the main contribution to genetically significant dose and the G. I. series, chest fluoroscopies, and photofluorographies to mean bone marrow dose. (auth)

27118 (CONF-730907-P2, pp 1150-1155) USE OF MEDICAL X-RAY DIAGNOSTIC UNITS IN IRAQ. Abbas, M. S. (Ministry of Health, Baghdad, Iraq). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The medical use of x rays represents a major source of population radiation exposure. A special consideration is given to assess the genetically significant dose due to diagnostic radiology. All medical institutions, hospitals, private physicians and dentists in Iraq, were visited to record: the number and type of x-ray units, the frequency and kind of x-ray diagnostic examinations and number of workers in such units. In addition the protection of the workers from the radiation and the services of personnel monitoring were also observed. It was found that, up to the end of 1972, there are 407 x-ray units, all over the Republic used for whole body medical roentgenodiagnosis and 146 x-ray units for dental radiography, carrying out more than 4×10^6, and 15×10^4 examinations per year, respectively. The study gives a clear map of the distribution of the x-ray units in the different parts of the country and can be used as a guide for future radiological health programs. It might also serve as a model for radiation survey and inspection. Also, the figures could be useful in the estimation of the annual genetically significant dose received by the 10 million Iraqis from exposure to diagnostic x rays. (auth)

27119 (CONF-730907-P2, pp 1180-1184) REDUCTION OF RADIATION EXPOSURE TO NUCLEAR MEDICINE PERSONNEL BY THE USE OF NEW TECHNIQUES FOR PREPARATION OF TECHNETIUM RADIOPHARMACEUTICALS. Robbins, P. J.; Branson, B. M.; Grant, R. J. (Bureau of Radiological Health, Cincinnati). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Radiation exposure to the hands from the preparation of ^{99m}Tc-Sn-MAA from an instant kit and ^{99m}Tc-HAM from a non-instant kit has been measured by thermoluminescent dosimetry (TLD). The exposure to the fingers from the preparation of 100 mCi of ^{99m}Tc-HAM exceeded the exposure from preparation of the same amount of ^{99m}Tc-Sn-MAA. An exposure of 153 mR/100 mCi of prepared radiopharmaceutical to the left middle finger was the highest value recorded in the study. (auth)

27120 (CONF-730907-P2, pp 1185-1190) REDUCING PERSONNEL EXPOSURE IN NUCLEAR MEDICINE. Branson, B. M.; Hoops, R. G.; Grant, R. J. (Bureau of Radiological Health, Cincinnati). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Nuclear medicine procedures are growing at a rate greater than 15%/yr and the radiopharmaceutical industry over 25%/yr. A nuclear medicine facility in a medium-large hospital routinely handles 300 to 700 mCi of ^{99m}Tc/day plus prepares ^{99m}Tc radiopharmaceuticals and handles millicurie amounts of other isotopes. As this specialty grows, so must exposure reduction techniques.

Periodic assessment of personnel handling the molybdenum-technetium generators and ^{129}Cs were made using TLD's. These data are reviewed with comments about potentials for personnel exposures and exposure reducing methods. Additional shielding and new handling techniques have been incorporated and are discussed. (auth)

27121 (CONF-730907-P2, pp 1191-1196) RADIOPROTECTION IN A NUCLEAR MEDICINE UNIT. Favino, A.; Besseghini, G. F. (Univ., Pavia, Italy). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The main aspects of the radioprotection program of a Nuclear Medicine unit organically included in the services of an Occupational Diseases Institute are described and discussed. Analysis of the records of the environmental and personal dosimetry points out to the opportunity for monitoring particularly of the internal contamination. The need for employing usual diagnostic equipment for regular monitoring of the working staff is stressed. Due to the increasing diffusion of WBC for diagnostic applications, scheduling of this tool for monitoring of the personnel is recommended. A transportable WBC of the shadow type susceptible to be transferred from the laboratory to a mobile unit in less than half an hour is described for clinical and radioprotection applications including monitoring of operators handling gamma emitters in medical units and in industry when no facilities for internal dosimetry are available. Monitoring of the excreta of patients submitted to radiometabolic therapy has been one of the aims of the health physics programs in this Nuclear Medicine unit. An original system for monitoring liquid radioactive waste is described as a first step for ecologic control of spreading of radioactive contamination. (auth)

27122 (CONF-730907-P2, pp 1197-1202) RADIATION PROTECTION IN A NUCLEAR PHARMACY. Ice, R. D.; Hetzel, K. R. (Univ. of Michigan, Ann Arbor). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Regional nuclear pharmacies are emerging throughout the world to meet the increased demands for radiopharmaceuticals. A radiation protection program for a nuclear pharmacy encompasses facility design, quality control, dispensing and documentation, and provides for increased utilization of radiopharmaceuticals. The resultant radiation protection program is synergistic between health physics and pharmacy principles. (auth)

27123 (CONF-730907-P2, pp 1261-1286) PROTECTION PROBLEMS INVOLVED WITH NON-IONIZING RADIATION. Jammet, H. (CEA, Fontenay-aux-Roses, France). Feb 1974. (In French).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Considering the growing utilization of non-ionizing radiation and the spreading danger from workers to the general population, the nature, sources and conditions of exposure to non-ionizing radiations, their interaction with matter, their biological and pathological effects are reviewed and the present situation of protection as to regulations, operational principles, and monitoring is discussed at the international and national levels. (auth)

27124 (ORAU-123) 1973 RESEARCH REPORT FOR YEAR ENDING DECEMBER 31, 1973. (Oak Ridge Associated Universities, Inc., Tenn. (USA). Medical Div.). 1973. 174p. Dep. NTIS $7.60.

Separate abstracts were prepared for three sections of this report. (CH)

For abstracts of individual sections see: 27125, 27159, and 27290.

27125 (ORAU-123, pp 4-53) RADIATION EFFECTS AND RELATED TOPICS. 1973.

In 1973 research report for year ending December 31, 1973.

A major objective of the research program is to elucidate radiation effects in the human being in order to better manage the rare accidental exposures that occur, and also to use total-body irradiation for therapy when it is useful. The therapeutic applications involve moderate doses used to suppress the proliferative activity in chronic hematologic disorders including chronic leukemias, lymphoma, and polycythemia, and large doses for immunosuppression in preparation for marrow grafting. The work on total-body irradiation includes dosimetry, physiological monitoring, prodromal effects, hematologic changes, cytogenetic effects, and the role of infection. (auth)

27126 (WASH-1336) ORIGIN AND SIGNIFICANCE OF RADIATION DOSE LIMITS FOR THE POPULATION. Taylor, L. S. (USAEC Division of Biomedical and Environmental Research, Washington, D. C.). 17 Aug 1973. 20p. Dep. NTIS $4.00.

The development of radiation protection standards for the general population in the USA is reviewed with emphasis on the role of the National Council on Radiation Protection (NCRP). It is pointed out that available data on radiation effects on man do not reflect pathological changes at doses below the order of 100 rems based on data on acute exposure to large doses at relatively high dose rates. The large amount of data on personnel exposed to chronic dose levels ranging from 1 to 15 rads per year show no pathological changes. The philosophy of the linear and no-threshold concepts of radiation injury is discussed. Analysis of available data indicate that the cancer risk from low dose-rate exposures may be higher than previously thought. In 1973 the average radiation dose limit recommended for the general population for exposure to all sources of radiation other than natural sources or medical applications was 170 millirems per year, with individual exposures not to exceed 0.5 rems per year and the whole-body exposure not to exceed 0.17 rems per year. Estimates made on the radiation dose to the population resulting from the operation of all nuclear power plants proposed by the year 2000 project an annual dose of not greater than one milirad. It is emphasized that because of the lack of evidence of injurious effects of low dose radiation any changes in recommendations for dose limits for exposure to environmental radioactivity must be based on the judgement of those involved in setting NCRP standards. (CH)

27127 GRAFT-VERSUS-HOST DISEASE. Gatti, R. A.; Kersey, J. H.; Yunis, E. J.; Good, R. A. Progr. Clin. Pathol.; 5: 1-18(1973).

Various aspects of graft-versus-host disease are reviewed under the following headings: the susceptible host; histoincompatibility; diagnosis of the disease in animals and man; pathogenesis; and prevention and treatment. The use of lethal irradiation to create susceptible hosts for animal experiments is pointed out and the reversal of fatal effects of lethal radiation on mice by transplants of spleen cells is discussed. Studies on chick embryos showed that if the embryos are irradiated before inoculation with donor cells, the pock count is reduced. (HLW)

27128 BIOCHEMICAL MEASUREMENT OF THE EFFECT OF RADIATION ON THE CANCER OF THE CERVIX OF THE UTERUS. Miura, S.; Hirota, Y.; Hamanaka, N.; Tani, T.; Kuratomo, K. (Osaka Univ.). Nippon Sanka Fujinka Gakkai Zasshi; 26: No. 1, 65-66(Jan 1974). (In Japanese).

In order to accurately measure the effect of radiotherapy upon the tissues of uterine cancer, a biochemical radiosensitivity test was developed by indicating the speed of DNA synthesis. In addition, it was assumed that this method could be used as a clinical test. First, punch biopsy was locally performed before and after radiotherapy in cases of uterine cancer. The speed of the DNA synthesis of these tissues was measured. After the collected samples were incubated with ^{3}H-thymidine, ^{3}H-thymidine incorporation into the DNA fraction and TCA soluble fraction was measured. The speed of DNA synthesis was indicated by D/T ratio (DNA fraction/TCA fraction). In cases with 600 rads irradiation, the D/T ratio was decreased in less than 20%, compared with that before irradiation. In cases with 900 to 1200 rads, there was a remarkable decrease (72.9%). Furthermore, it was decreased and the individual susceptibility was extremely small with increase of irradiation dose. Therefore, it seemed that radiotherapy with about 1000 to 2000 rads, by which the T/D ratio remarkably decreased and the individual susceptibility was evident, was applicable as the radiosensitivity test. (JA)

27129 BIOLOGICAL RELATIONSHIP BETWEEN AGING AND RADIATION. Sugahara, T. (Kyoto Univ.). Nippon Rinsho; 32: No. 1, 30-36(Jan 1974). (In Japanese).

The influence of radiation on the life span of mice was shown by means of the Gompertz function. Data are also reported on comparisons of the average age of mortality of radiologists in the United States and on atomic bomb survivors in Hiroshima and Nagasaki. Although mortality was increased by radiation, the relation between aging and radiation was not evident. Studies on experimental animals showed relationships between kidney

function and age and between blood pressure and age. The relationship between radiation dose and life span shortening was also considered. Studies on effects of radiation on DNA and radioinduced mutations are needed to determine the relation between aging and radiation. (HLW)

27130 STERILITY IN JAPANESE RADIOLOGICAL TECHNICIANS. Kitabatake, T.; Watanabe, T.; Sato, T. (Niigate Univ.). Tohoku J. Exp. Med.; 112: No. 3, 209-212(Mar 1974). (In Japanese).

Questionnaires were sent to 1,005 radiological technicians of ages over 60 years in order to know the frequency of sterility including infertility. Of these, 418 responded and 393 (39.1%) were usable for analysis. In 110 (28.0%), their wives had no childbirth in the first three years of marital life, and 33 (8.4%) have never had childbirth until 60 years of age. These rates of sterility are significantly higher than those of the general population in Japan in 1951. In persons who married before 1930 and are considered to have been exposed to radiation more than 400 R/year, absolute sterility tended to occur more frequently. (auth)

27131 KONTSEPTSIYA BIOLOGICHESKOGO RISKA VOZDEYSTVIYA IONIZIRUYUSHCHEGO IZLUCHENIYA. (Concept of Biological Risk From the Effect of Ionizing Radiation). Moskalev, Yu. I.; Dibobes, K. K.; Zhuravlev, V. V.; Ryadov, V. G.; Moiseev, A. A.; Terman, A. V. Moscow; Atomizdat (1973). 68p.

The concept of biological risk from the effect of ionizing radiation is discussed under the following general headings: the biological risk of ionizing radiation and evaluating probable consequences of exposure; quantitative evaluation of the consequences of the action of certain non-radiation and radiation factors; conception of levels of risk depending on dosage and conditions of radiation action; evaluation of the danger from incorporated radioactive substances; and some questions of establishing norms and organizing protective measures among the population for extraordinary circumstances. (ERB)

27132 UTILIZATION OF CHROMOSOME ANALYSIS AS AN IRRADIATION DOSIMETER. Biola, M. T.; Le Go, R. (CEN, Fontenay-aux-Roses, France). Rayonnements Ionis. Tech. Mes. Prot.; No. 2, 63-70(Apr 1974). (In French).

From eighth Congress of Health Physicists Association; Chatenay-Malabry, France (5 Jun 1973).

Blood lymphocytes form a cell population which is very suitable for the biological dosimetry of irradiation. The induction of chromosome anomalies is the same in the in vivo circulation as it is in vitro blood samples. It was thus possible to estimate the dose by exposing in vitro blood samples to ^{60}Co γ radiation. In practice, the sensitivity of such a dosimeter is of the order of 15 rems. An advantage of the chromosome dosimeter resides in the long duration over which the dosimetry estimation remains valid. (FR)

27133 OSTEORADIONECROSIS OF THE MANDIBLE RESULTING FROM EXTERNAL MEGAVOLTAGE RADIATION THERAPY. Cheng, V. S. T.; Wang, C. C. (Massachusetts General Hospital, Boston). Radiology; 112: No. 3, 685-689(Sep 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

The NSD and TDF concepts were used to evaluate the tumor and mandibular radiation dose levels of 13 patients with and 63 without osteoradionecrosis of the mandible following a curative course of megavoltage irradiation for carcinomas of the tonsillar region. The midplane tumor doses were from 1,600 to 2,100 RET (TDF 85–135); the mandibular doses ranged from 1,700 to 3,000 RET (TDF 102-223). The 13 patients with osteoradionecrosis received mandibular doses from 2,000 to 2,900 RET (TDF 126-212). The treatment factors contributing to the high mandibular dose and the role of this dose in the development of mandibular osteoradionecrosis are discussed. (auth)

27134 BRAIN TUMORS IN CHILDREN: ANALYSIS OF 136 CASES. Abramson, N.; Raben, M.; Cavanaugh, P. J. (Duke Univ., Durham, NC). Radiology; 112: No. 3, 699-672(Sep 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Between 1960 and 1971, 136 children with inoperable or partially resectable brain tumors were treated in the Division of Therapeutic Radiology at Duke University. The treatment approach to each major type of tumor is discussed, including radiotherapy techniques and time-dose relationships. Results are presented with regard to survival time, complications of radiation, symptomatic relief and quality of survival. Particular emphasis is placed on the question of retreatment and tolerance of the brain to irradiation. (auth)

27135 RADIATION DOSE TO EYE LENS AND GONADS DURING TRANSFEMORAL CEREBRAL ANGIOGRAPHY. Quisling, R. G.; Seeger, J. F.; Gabrielsen, T. O.; Kanellitsas, C. (Univ. of Michigan, Ann Arbor). Radiology; 112: No. 3, 71-717(Sep 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Ninety-two randomly selected patients undergoing transfemoral cerebral angiography were studied to determine eye lens and gonadal radiation exposures. The mean individual lens exposure was 12.4 rads with a range of 0.5 rad to 35.5 rads. The mean gonadal exposure was below 0.004 rad for all but one patient. The right eye received a mean dose 28% greater than the left in 82% of cases. The mean lens exposure increased proportionately to the mean number of vessels studied and to the number of films exposed, while the relative contribution of fluoroscopy time was considerably less pronounced. Proper collimation during filming of extracranial studies and lateral projections of intracranial studies, particularly in vertebral angiography, can significantly reduce lens exposure. (auth)

27136 CALCIFICATION IN MEDIASTINAL LYMPH NODES AFTER RADIATION THERAPY OF HODGKIN'S DISEASE. Brereton, H.; Johnson, R. E. (National Institutes of Health, Bethesda, MD). Radiology; 112: No. 3, 705-707(Sep 1974).

Calcification of mediastinal lymph nodes after radiation therapy of Hodgkin's disease usually occurs in patients with clinically localized disease who present without constitutional symptoms and have a favorable clinical course. A particularly high incidence of calcification has been observed so far in those patients given a higher than average radiation dose to the nodes which subsequently became calcified. (auth)

27137 INTRACAVITARY DOSIMETRY FOR CARCINOMA OF THE CERVIX AND SUBSEQUENT COMPLICATIONS. Buchler, D. A.; Kline, J. C.; Carr, W. R. (Univ. of Wisconsin, Madison). Amer. J. Obstet. Gynecol.; 120: No. 1, 83-90(1 Sep 1974).

The isodose curves from 464 patients treated for invasive carcinoma of the uterine cervix were reviewed for any relationship to subsequent complications. If intracavitary radiation was emphasized, the amount and arrangement of the radioactive sources in a specified volume were more significant than just the range of milligram hours or rads to Point A when the bowel complications were reviewed. When external irradiation to the whole pelvis was the main portion of the treatment plan, the range of rads to Point A from the intracavitary radium insertion related to subsequent bowel problems. Those patients having a central stem for the intracavitary had more bowel complications than when tandem and ovoids were used. (auth)

27138 MEMORIAL IMPLANT DOSIMETRY AUTOMATED SYSTEM. Randall, G.; Balter, S.; Holt, J. G.; Laughlin, J. S. (Memorial Hospital for Cancer and Allied Diseases, New York). Comput. Programs Biomed.; 2: 137-152(Apr 1972).

The current status of computer programs and procedures for implant radiation sources dosimetry for therapy at Memorial Hospital is reported. The implant dosimetry programs and associated procedures have been given the name MIDAS: Memorial Implant Dosimetry Application System. A short history of MIDAS, as well as program objectives, conventions, assumptions and organization are discusses and a complete sample case is shown with explanatory annotations for a ^{226}Ra source. (CH)

27139 SURGICAL SCIENCE IN FRANCE. The Greater Omentum in Repair of Complications Following Surgery and Radiotherapy for Certain Cancers. Abbes, J. J. L.; Richelme, H.; Demard, F. (Centre Contre le Cancer, Nice). Int. Surg.; 59: No. 2, 81-86(Feb 1974).

Transposition of greater omentum from the abdominal cavity to repair sequelae of combined surgical and radiotherapeutic treatment of cancer in four cases is presented. One axillary radionecrosis and three oropharyngostomas developed after extensive reconstructive surgery following radiotherapy. The theoretical possibilities for using this method were developed by reviewing the attributes of the G. O. (anti-infectious, immune, and trophic). The technical aspects of lengthening it in order to reach the neck, armpit or scalp are then analyzed. Favorable results agree with the use of G. O. in other domains. (auth)

27140 RADIATION AND SMALL BOWEL COMPLICATIONS IN CERVICAL CARCINOMA THERAPY. Maruyama, Y.; Van Nagell, J. R. Jr.; Utley, J.; Vider, M. L.; Parker, J. C. (Univ. of Kentucky, Lexington). Radiology; 112: No. 3, 699-703(Sep 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Small bowel complications developed in 9 patients 6-60 months following radiotherapy for carcinoma of the cervix. A phenotypic profile of unusual sensitivity was determined from analysis of patient characteristics. Four patients were diabetic, three were hypertensive and diabetic, five had Stage III disease, and all were either underweight or of normal weight. Only one had previous abdominal surgery. All received at least 4000 rads of external beam therapy. Complications developed in patients with one or two radioactive implants. Small bowel problems are particularly prone to develop in patients of small habitus with preexisting small vessel disease, especially as evidenced by hypertension and diabetes. (auth)

27141 PARTITION FIELD IRRADIATION TECHNIQUE IN THE ROCUS TELEGAMMA-TREATMENT DEVICE. Mitrov, G. Rentgenol. Radiol.; 12: No. 3, 187-190(1973).

A screening set up is described for irradiation after the partition field technique in the Rocus telegamma-treatment device consisting of a lead block and appliances for its rapid installing always in one and the same place toward the appliance head and for directing the ray beam. Dosimetric studies of the dosage field obtained by means of the screening set up were made at source-surface distances of 75 and 60 cm. Isodosage charts were built which may be used for planning radiation therapy according to this method. The method was applied for combined radiation treatment of cancer of the uterine cervix and for irradiation of the cervical lymph basin. (auth)

27142 PULMONARY COMPLICATIONS IN MEGAVOLTAGE THERAPY FOR BRONCHIAL CANCER. Rabinovich, R. M.; Shapiro, I. B. Central Research Roentgeno-Radiological Inst., Leningrad). Vop. Onkol.; 20: No. 6, 34-42(1974). (In Russian).

Clinico-roentgenological features in complications, developed, due to radiotherapy for bronchial cancer in the atelectatically collapsed and intact segments of 188 patients with bronchial cancer, treated by megavoltage radiation, have been studied. This study has demonstrated that the atelectatic pulmonary tissue is more susceptible to the effect of ionizing radiation. Radiation lesions in atelectatic portions are manifested as radiation pneumonias and pneumofibrosis, or a destruction of the lung parenchyma with a grave course and unfavorable prognosis. In the intact pulmonary tissue radiation lesions are manifested as radiation pneumonias resulting in pneumofibrosis in a satisfactory patient's state. Observations for 2 years and longer have evidenced fibrous changes, related with a damaging effect of radiation, practically in all these patients. (auth)

27143 THE MUTAGENIC EFFECT OF X RAYS. P. 2. Influence on the Mutation Rate. Stephari, G. (Bundesgesundheitsamt, Berlin (F. R. Germany). Abt. Fuer Strahlenhygiene). Roentgen Bl.; 27: No. 7, 348-354(Jul 1974). (In German).

5 figs.; 13 refs.

The mutation rate is influenced both by biological and physical factors. It depends on the developmental stage of the gametes: after irradiation spermatids and spermatozoons show a mutation rate two times higher than the spermatogonions. Also the stage of cell division is important. After DNA-synthesis, which has taken place in the late prophase an increased radiation susceptibility is observed. Dose rate influences mutation rate insofar as the latter increases with increasing dose rate, oogonions showing a larger susceptibility than spermatogonions. RBE, too, correlates with the mutation rate; with neutron irradiation spermatogonions show a considerably higher mutation rate than with gamma irradiation. Furthermore, the mutation rate is influenced by the type of fractionation and protraction of a total dose and by the radiation free interval. The relationships, however, are not yet known. The living cell possesses mechanisms permitting the elimination of radiation-induced changes in its genetic material. (auth)

27144 NATIONAL CANCER CENTER RADIOTHERAPY COMPUTER SYSTEM. Umegaki, Y. (National Cancer Center Hospital, Tokyo); Sakudo, M.; Amari, H.; Matsukawa, S.; Inamura, K.; Otani, S. Comput. Programs Biomed.; 2: 200-215(1972).

Programs and hardware configuration presently utilised in a dedicated real-time computer system for processing vital information concerning radiation therapy of neoplasms are described. The program covers simulation of 2-dimensional 6-MeV external beam therapy for isocentric techniques, including wedge and screening filters; intracavity radium therapy; combination of external beam and source implants therapy; and the medical data needed for treatment evaluation. (auth)

27145 PHASE X RAY SENSITIVITY OF HUMAN LYMPHOCYTES TO THE ACTION OF PROTONS. Todorov, S.; Ivanov, B., Mileva, M. Eksp. Med. Morfol.; 12: No. 3, 142-145(1973).

Data are presented on a cytogenetic analysis of lymphocytes from human peripheral blood, irradiated at the stage G_0 and G_2 of the cellular cycle. There was an increase of chromosomal aberrations with the increase of the dose. Moreover irradiation at stage G_0 induced aberrations of chromosomal type, whereas irradiation at stage G_2-aberrations of chromatid type. The increase of one hit aberrations were of linear character at both stages. (auth)

27146 CLINICAL OBSERVATIONS IN RADIATION DAMAGE. Bublitz, G. (Inst. fuer Roentgendiagnostic and Nuclear Medicine, Brunswick). Verh. Deut. Ges. Kreislaufforsch.; 56: 188-191 (1972). (In German).

General irradiation effects such as acute and chronic damage at various organs are rare if one uses an adequate radiation technique, exact dosimetry, and functional control studies at regular intervals. The human skin and subcutaneous tissues must be considered as a very sensitive organ exposed to ionizing radiation. One of the best known advantages of supervolt-therapy is the lower exposure of the skin and subcutaneous layer. Even more significant is the fibrosis of the lungs. The underlying histological substrate of pulmonary fibrosis was analyzed by electron-microscopy and biochemical investigation. The results of our investigations give a clearer definition in regard to therapy and prognosis. (auth)

27147 THE DOSE DISTRIBUTIONS IN FIELDS OF SOME SIEMENS COBALT UNITS AND THEIR SIMULATION BY A MATHEMATICAL MODEL WITH A SURVEY OF ITS ACCURACY. Patomaeki, L. K.; Verho, S. (Kuopio Univ. (Finland). Dept. of Physics). Strahlentherapie; 147: No. 3, 231-241(Mar 1974).

8 figs.; 4 tabs.; 16 refs.

A general mathematical model has been fitted to measured percentage dose distributions of two radiation therapy cobalt units. The accuracy of the model in describing the dose distributions in single fields was carefully studied and found adequate in dose planning. The model permits relative dose calculations for any arbitrary field size and any arbitrary source-to-skin distance (within the stated limits) at any point within the irradiated volume. The suitability of the model for computerized dose planning with mini-computers is suggested. (auth)

27148 THE RELATION BETWEEN RADIATION DOSE AND SOMATIC RADIATION RISK. Jacobi, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F.R. Germany). Inst. fuer Strahlenschutz). Atomwirt., Atomtech.; 19: No. 6, 278-283(Jun 1974). (In German).

From reactor meeting; Berlin, F. R. Germany (2 Apr 1974).

6 figs.; 13 refs.

Recent radiobiological results lead to the conclusion that under the influence of ionizing radiations, as for example x, gamma, electron, and beta radiation, a non-linear dose-effect-relation is more likely than a linear relation. This statement is of great importance, because the professional radiation exposure as well as the radiation exposure of the population is caused almost exclusively by this type of radiation. Moreover, the frequency of radioinduced cancer depends also on the dose rate, i.e., the risk to get cancer of a total dose D decreases, if this dose is dispersed over a longer period of time. Risk analyses, recently carried out independently in the FRG and in USA showed universally that in the field of lower doses the cancerogeneous effect of x, gamma, and beta radiation is considerably lower than estimated up to now. (auth)

Vertebrates

Refer also to abstract 27010.

27149 (AD-777032) BONE MARROW RESPONSE OF BEAGLES TO FRACTIONATED DOSES OF MIXED GAMMA-NEUTRON RADIATION. West, J. E.; Mitchell, F. A.; Jones, S. R.; Witz, J. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Sep 1973. 23p. (AFRRI-SR-73-15). NTIS $4.25.

Male beagles were bilaterally exposed to mixed gamma-neutron radiation from the AFRRI-Triga reactor. The dose rate was 20 rads/minute for all irradiations and midline tissue doses were 215, 225, and 240 rads. At each dose approximately one-half of the animals received a single irradiation while the others were given one-fourth the dose each day for four consecutive days. The objective of this study was to determine if doses in the median lethal range delivered in four equal fractions at 24-hour intervals were more lethal and more damaging to survival-limiting hematopoietic cell renewal systems than similar unfractionated doses. Single irradiations were the more lethal, first evident at 225 rads and increasing markedly in effectiveness at 240 rads. Radiation-induced changes in bone marrow cellularity were similar after single and fractionated irradiations. (GRA)

27150 (AD-777033) MEASUREMENT OF CANINE INTESTINAL CAPILLARY BLOOD FLOW IN THE TERMINAL PHASE OF THE GASTROINTESTINAL RADIATION SYNDROME. Kabal, J.; Parkhurst, L. J.; Wyant, D. E. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Nov 1973. 15p. (AFRRI-SR-73-18). NTIS $3.00.

Beagles were divided into two groups, one of which was sham irradiated while the other was subjected to 1500 rads of whole-body pulsed gamma-neutron radiation. Seventy-two hours post-irradiation, radioactive-tagged microspheres were injected directly into the left ventricle of the heart. The results showed that the intestinal capillary blood flow (in percent of cardiac output) of the irradiated dogs was higher than that of the nonirradiated dogs. Although the weight of the mucosal layer of the small intestine decreased significantly postirradiation, its relative capillary blood flow remained at the preirradiated level, indicating increased capillary blood flow per unit weight of mucosa. The method was successfully applied to the measurement of mucosal flow as a function of cardiac output and can be applied to the study of the pathophysiology of a variety of stresses, including irradiation. (GRA)

27151 (CONF-730907-P1, pp 85-90) COMBINED EFFECT OF IONIZING RADIATION AND A SUPERHIGH-FREQUENCY FIELD ON THE BODY. Liberman, A. N.; Bronstein, I. E.; Orobei, V. V.; Sakovskaya, M. S.; Tchesnokova, A. P.; Shubik, V. M.; Bikkulov, R. I. (Inst. of Radiation Hygiene, Leningrad). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Prolonged investigations of white mice and white rats showed fractional combined x-ray longwave (30 R of single exposure) and SHF (5 mw/cm^2, 20 min) irradiation to be responsible for more pronounced effects than those caused by these factors acting independently. The differences detected were in body and some organ's weight, in lysozymes per liter of serum, in productibility of animals, and in chromosomal aberrations number in bone marrow. At combined x ray, short-wave, and SHF-irradiation the intensification of effect was not found. Observations showed that combined occupational effect of x rays of different energy and SHF irradiations caused more frequency deviations of organism functional state than SHF field irradiation only. (auth)

27152 (CONF-730907-P1, pp 129-135) EFFECT OF FLUORINATION OF DRINKING WATER AND A CALCIUM-AUGMENTED DIET ON THE RADIOTOLERANCE OF ANIMALS DURING EXTERNAL GAMMA IRRADIATION. Knizhnikov, V. A.; Grozovskaya, V. A. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In experiments on 2,016 albino rats it was found that continuous high levels in the intake of fluorine with drinking water and calcium with the diet increases the animal survival by 1.5 to 2 times after single or fractional total-body γ or x irradiation at doses of $LD_{10/30}$ to $LD_{70/30}$. In experiments on 205 rats was found that fractional irradiation at total doses of 200 R did not cause radiation disease but shortened the animal's life by 10%. The addition of calcium and fluorine to the diet considerably neutralizes the negative influence of the irradiation on duration of life. (auth)

27153 (CONF-730907-P1, pp 147-152) COMPARISON OF THE BIOLOGICAL EFFECT OF INTERNAL STRONTIUM-90, CESIUM-137, IODINE-131, AND EXTERNAL IRRADIATION. Zapol'skaya, N. A.; Borisova, V. V.; Zhorno, L. Ya.; Lavrent'ev, L. N.; Pavlitskaya, E. D.; Fedorova, A. V.; Yakovleva, N. G. (Inst. of Radiation Hygiene, Leningrad). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A comparative estimate was made of the biological effect of ^{90}Sr, ^{137}Cs, ^{131}I, and external γ irradiation on albino rats under conditions of chronic exposure. In the range of the commensurate doses and exposure times, the relative radiotoxicity of ^{90}Sr, ^{137}Cs, and external irradiation according to hematological and biochemical indices and lifespan was found to be close to unity. The effectiveness of ^{131}I according to the same indices was considerably lower. As to the incidences of malignant tumors, the effects of ^{90}Sr proved to be in excess of those for ^{137}Cs, ^{131}I, and external γ irradiation. (auth)

27154 (CONF-730907-P1, pp 153-158) REMOTE AFTER EFFECTS FOLLOWING EXTERNAL BETA IRRADIATION. Moskalev, Yu. I.; Shelesnova, V. I.; Milovidova, A. I. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The effect of various doses (from 600 to 7200 rad) from a ^{90}Sr–^{90}Y source of external β irradiation on life duration, frequency and rate of skin and mammary tumor development, and cataract induction (whole-body irradiation and irradiation of the front and back parts of the body) was studied in rats. The effective dose values of acute ($LD_{50/30}$), subacute ($LD_{50/120}$), and chronic ($LD_{50/360}$) radiation exposure were lower after whole-body irradiation (4750, 4680, and 3240 rad respectively) than after irradiation of the front (5960, 5120, and 4310 rad) or back (6910, 5830, and 5380 rad) parts of the body. Benign tumors (adenoma of sebaceous glands, fibroma) and malignant tumors (basalioma, flat-cell cancer, sebaceous gland cancer, sarcoma) skin tumors, benign (adenoma, adenofibroma, fibroadenoma, fibroma) and malignant (cancer, sarcoma) mammary tumors and cataracts developed at late periods in the irradiated parts of the body after exposure to all doses. Frequency and rate of skin and mammary tumor development and cataracts were proportional to the irradiation dose. (auth)

27155 (CONF-730907-P1, pp 172-177) BIOLOGICAL EFFECTS OBSERVED WITH COMBINED EXPOSURE TO RADIATIONS. Kalistratova, V. S.; Katsapov, I. S.; Trifonov, V. I. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In experiments on white rats, the combined effects of ^{131}I, ^{241}Am, HTO, and of external radiation sources were studied. The results obtained indicate that combining of internal irradiation and whole-body external gamma-irradiation in various combinations can be expressed differently, i.e., either by summation of the pathological effects or by their increase or decrease. (auth)

27156 (CONF-730907-P1, pp 178-183) CHARACTERISTICS OF THE COMBINED EFFECT OF RADIOACTIVE SUBSTANCES (IODINE-131, PROMETHIUM-147) AND EXTERNAL RADIATION ON THE BODY. Burykina, L. N.; Oriyanskaya, R. L.; Ponomareva, V. L.; Vasil'eva, L. A.; Veselovskaya, N. A.; Zhanadilov, Sh.; Mel'nikova, L. N. (Inst. of Industrial Hygiene and Preventive Medicine, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The forms of radiation diseases caused by external (γ, x rays) and internal (^{147}Pm, ^{131}I) sources of radiation in rats were studied. A distinctive effect of the disease was discovered in adult rats during exposure to both ^{147}Pm and external radiation. The age of the animals was found to affect the course of the combined radiation diseases (due to ^{131}I and x rays). The younger rats (36 to 42 days old) proved to be more radiosensitive as compared to the adult ones (2 to 2.5 months old). The effects of ^{131}I and external radiation as measured by the hematological criteria were determined. (auth)

27157 (CONF-730907-P1, pp 184-189) QUANTIFICATION OF POST-IRRADIATION LEUKOCYTE DATA RELATIVE TO ESTIMATING EFFECTIVE EXPOSURE. Angleton, G. M. (Colorado State Univ., Fort Collins); Robinette, C. D.; Carter, P. B.; Wailly, L. F. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

An exponential model was used in a study of the post-irradiation response pattern of leukocytes in young male beagles given whole-body subacute bilateral exposures to ^{60}Co γ radiation. The post-irradiation sensitivity of the minimum relative leukocyte count as characterized by the rate parameter was estimated to be –0.7% per R. Conversely, a maximum post-irradiation depression of 25% could be used to infer that an individual had been subjected to an effective equivalent exposure of 40 R. (auth)

27158 (EUR-4672) NUCLEAR TECHNIQUES APPLIED TO SELECTED MEDICAL PROBLEMS. Annual Report 1969. (Com-

mission of the European Communities, Brussels (Belgium); Pisa Univ. (Italy); Brussels Univ. (Belgium)). 1971. 18p. (In French). INIS.

The activities of the Brussels group, since 1969, have been centered on the study of two types of tissue irradiation targets: blood cell lines and intestinal mucosa. In the area of hematopoiesis, the action of x-irradiation on the regulation of hematopoiesis by erythropoietin was studied in the rat. It was shown that the response of the erythropoietin rate to bleeding was much more sharp in the irradiated animal. The bone blood flow was studied in man. It was evaluated at 3% of the total blood flow. The relations between bone blood flow and the erythropoietic activity were studied. The polynuclear leucocytes were studied from the viewpoint of their phagocytic activity. For the purpose of studying the regulation of this process, an original method for the determination of cyclic 3',5'-AMP was developed. In order to study the inhibition of leucopoiesis by chloramphenicol and by irradiation, the study of the protein synthesis in the mitochondria was undertaken. The study of the mitotic parameters of the intestinal mucosa in man was done by double labelling measurement of these parameters in mucosa fragments taken by biopsy. The validity of this method was verified in the dog. (tr-auth)

27159 (ORAU-123, pp 91-143) BASIC STUDIES IN RADIATION, NEOPLASIA, IMMUNOLOGIC RESPONSES, AND METABOLISM. 1973.

In 1973 research report for year ending December 31, 1973.

Results are reported from studies of enzyme reactions involved in the biosynthesis of lipids in neoplastic cells and the role of enzyme preparations from lung ademomas in the biosynthesis of pulmonary surfactants. Marmosets were found to develop a disease resembling human idiopathic thrombocytopenic purpura following isoimmunization with leukocyte-platelet preparations and also to develop spontaneous colon neoplasms which indicates they may be satisfactory animals for research on these diseases. (CH)

27160 CYTOGENETIC EFFECTS OF X-RAYS AND FISSION NEUTRONS IN FEMALE MICE. Searle, A. G.; Beechey, C. V. (Medical Research Council, Harwell, Eng.). Mutat. Res.; 24: No. 2, 171-186(Aug 1974).

The induction by x rays of chromosomal damage in oocytes was studied, while the genetic consequences of x- and neutron-induced damage in female mice were looked for by testing offspring for dominant lethality and semi-sterility. None out of 386 sons of hybrid females given 300 rad x rays showed evidence of semi-sterility or translocation heterozygosity, but 9 out of 294 daughters were diagnosed as semi-sterile. At least three and probably four of these (1.4%) carried reciprocal translocations, two of which caused male sterility. Complete or partial loss of the X-chromosome may have been responsible for some of the other semi-steriles. Examination of oocytes at metaphase-I during the first and third weeks after x irradiation with 100 or 400 rad revealed both multivalents (some of the ring quadrivalent type) and fragments (mainly double). These were thought to arise mainly from chromatid interchanges (both symmetrical and asymmetrical) and isochromatid intrachanges respectively. Since neither the proportion of asymmetrical interchanges nor the amount of hidden damage was known it was not thought possible to predict the magnitude of F_1 effects from metaphase-I findings. The aberration frequency in oocytes rose with dose and (at the 400 rad level only) with time after irradiation, reaching a maximum of 10% multivalents and 22% fragments in the third week after 400 rad. The frequency of univalents showed no consistent trend, but chiasma counts decreased in the first week after 400 rad. The increase in levels of chromosomal damage with dose and time after irradiation was reflected in dominant lethal frequencies after the same radiation-conception intervals and doses of 0 to 400 rad. Induced post-implantation lethality was over twice as high in the third week after 200 to 400 rad than in the first. Pre-implantation loss also greatly increased in the third week after 300 or 400 rad; this was associated with increased nonfertilization of ova. No evidence for the induction of translocations in oogonia or resting oocytes by fast neutron irradiation was obtained, although there was evidence for X-chromosomal loss after 200 rad to oocytes. The relative biological effectiveness (RBE) for fission neutrons vs. X-rays with respect to dominant lethal induction in oocytes was found to vary with dose, but seemed to be around 1 at lower levels. (auth)

27161 RADIATION SHIFTS IN GLUTAMIC METABOLISM IN THE BRAINS OF WHITE RATS IN RELATION TO THE DOSE AND METHOD OF IRRADIATION. Cherkasova, L. S.; Pikulev, A. T.; Dis'ko, N. A.; Chernoguzov, V. M.; Yakubovich, L. S.; Sholukh, M. V. Biokhimiya; No. 1, 37-50(1973). (In Russian).

It was concluded from experiments on white Wistar rats exposed to whole-body x-irradiation with the head or adrenal region screened or to local irradiation at 40, 100, and 700 R with the head or adrenal region screened that shifts in glutamic acid metabolism are related to the dose and method of irradiation. (Referativnyi Zh.)

27162 RADIOSENSITIVITY OF THE ISOENZYMES TRANSAMINASES IN DIFFERENT ORGANS OF LETHALLY X-IRRADIATED RATS. Pikulev, A. T.; Chernoguzov, V. M. Biokhimiya; No. 1, 80-85(1973). (In Russian).

The isoenzymes aspartate transaminases in the liver, myocardium, and brain of white rats x-irradiated at 700 R were found to be unequally sensitive to the radiation. The soluble isoenzyme was more sensitive under these conditions. The alanine transaminases were equally sensitive. (Referativnyi Zh.)

27163 EFFECT OF BETA IRRADIATION ON THE ACTIVITY OF ALANINE AND ASPARTATE TRANSAMINASES IN THE SUBCELLULAR FRACTIONS OF THE BRAIN AND MYOCARDIUM. Plenin, A. E. Biokhimiya; No. 1, 75-79(1973). (In Russian).

The rate of transamination catalyzed by alanine and aspartate transaminases in the brain and myocardium of white rats changed 1, 3, 7, 15, and 30 days after beta irradiation at a dose equivalent to 40 R. The nature and magnitude of the changes in activity of alanine and aspartate transaminases are dependent less on the type of ionizing radiation than on secondary processes in the irradiated organism. (Referativnyi Zh.)

27164 EFFECTS OF WHOLE-BODY X IRRADIATION ON LIPID PEROXIDE FORMATION OF ISOLATED MICROSOMES AND 9000 g SUPERNATANT FRACTION OF RAT LIVER. Lejsek, K.; Kvasnickova, E.; Hais, I. M. (Inst. of Medical Chemistry, Hradec Kralove, Czech.). Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, Suppl.; 15: No. 5, 491-495(1972).

The results did not show any increase in lipoperoxidation after whole-body irradiation (1000 R) during the determination of rat liver microsomal pethidine demethylation, while a significant increase in 9000 g supernatant fraction was caused by the irradiation of the animals. Possible explanations of these results are discussed. (auth)

27165 THERMOSTABILITY OF BLOOD SERUM OF DOGS EXPOSED TO A COMBINED EFFECT OF X IRRADIATION AND REDUCED BAROMETRIC PRESSURE. Vashuk, A. A. Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 3, 88-90(1974). (In Russian).

The blood from 100-, 350-, and 700-R x-irradiated dogs that were also subjected to low pressure conditions showed a greater increase in resistance to heat than those only irradiated. The effects were most marked in the 100- and 350-R groups on the third and subsequent days after the irradiation. Clinical signs of radiation sickness were also more evident in the doubly insulted dogs than in those only irradiated. (tr-auth)

27166 FORMATION OF CATARACTS IN MICE AFTER IRRADIATION WITH 645 MeV PROTONS AND ^{60}Co GAMMA-RAYS. Kabachenko, A. N. Kosm. Biol. Aviakosmicheskaya Med.; 8: No. 5, 31-35(1974). (In Russian).

The cataractogenic effect of 645 MeV protons and ^{60}Co gamma-rays at doses of 100, 200, 400, and 600 rads was studied. The first changes in the lens of mice were detected 8 to 10 weeks after irradiation. The time of the latent period was inversely proportional to the dose of proton and gamma irradiation. The degree and incidence of the cataract development were the function of the dose and the time elapsed after the irradiation. The clinical picture of cataracts induced by 645 MeV proton irradiation was similar to that of lenticular opacities brought about by other radiations. The relative biological effectiveness of 645 MeV protons was equal to unit as judged by the incidence of the cataracts induced. (auth)

27167 EFFECT OF BACTERIAL POLYSACCHARIDE ON THE AMOUNT OF ANTIBODY-PRODUCING CELLS IN THE SPLEEN OF IRRADIATED AND NONIRRADIATED MICE. Tumanyan, M. A.; Izvekova, A. V. (Inst. of Epidemiology and Microbiology, Moscow). Byull. Eksp. Biol. Med.; 78: No. 7, 69-72(Jul 1974). (In Russian).

A study was made of the effect of bacterial polysaccharide on the cells producing antibodies to sheep erythrocytes in the spleen of irradiated and nonirradiated mice. Polysaccharide proved to increase the amount of antibody-producing cells both in mice irradiated with lethal doses (gamma-rays) and in nonirradiated mice, nonimmunized and immunized with sheep erythrocytes. This increase was associated with the stimulation of proliferative processes in the organism by the polysaccharide. (auth)

27168 ACTION OF X IRRADIATION ON THE DNA SYNTHESIS AND MITOTIC ACTIVITY IN THE EPITHELIAL CELLS OF THE MOUSE UTERUS AT VARIOUS STAGES OF THE SEXUAL CYCLE. Mkrtchyan, S. A. (Ministry of Health, Erevan). Byull. Eksp. Biol. Med.; 78: No. 7, 98-100(Jul 1974). (In Russian).

Autoradiography with the use of thymidine-^{3}H was applied to the study of the action of x irradiation on DNA synthesis and mitotic activity of the epithelium in the uterine cavity at various stages of the sexual cycle. With local irradiation in a dose of 400 R the greatest reduction in the labeled nuclei index occurred at those stages of the sexual cycle at which a mass entrance of the cells into the period of DNA synthesis (the 3rd day of the oestrus and prooestrus) was observed. Depression of mitotic activity occurred with the action of irradiation at all the stages of the sexual cycle. (auth)

27169 EFFECT OF CYSTAMINE ON THE YIELD OF DOMINANT LETHAL MUTATIONS AND RECIPROCAL TRANSLOCATIONS IN GERM CELLS OF MALE MICE SUBJECTED TO GAMMA IRRADIATION. Pomerantseva, M. D.; Vilkina, G. A. (Inst. of General Genetics, Moscow). Genetika; 10: No. 7, 55-61(Jul 1974). (In Russian).

Protective effect of cystamine (150 mg/kg) against genetic damage induced by gamma irradiation in germ cells of male mice of CBA strain (at doses of 100, 300, 600 R) was studied. The application of cystamine decreased the frequency of dominant lethal mutations induced by radiation in sperms, spermatids, and spermatocytes. The degree of the protective effect of cystamine depended on a radiation dose. The protective effect of cystamine was the highest at the radiation dose of 300 R. It was negligible at the radiation dose of 100 R and was completely absent at the dose of 600 R. Cystamine did not affect the rate of induced reciprocal translocations in the spermatogonia at all the radiation doses used. (auth)

27170 CHANGES IN GLYCOGEN CONTENT AND UTILIZATION OF GLUCOSE IN THE BRAIN AFTER FRACTIONAL IRRADIATION AT LOW DOSE. Cherkasova, L. S.; Fomichenko, V. G.; Mironova, T. M. Biokhimiya; No. 1, 50-56(1973). (In Russian).

A study was made of the effect of total fractional x irradiation of Wistar rats at 40 R (13.3 PX3) and neutron irradiation of intermediate energies at 13.5 rads (3 times 4.5 rads each) on the content of glycogen and its fractions, glucoso-1-phosphate (G-1-P), glucoso-6-phosphate (G-6-P), ATP, and phosphocreatine in the brain. Twenty-four hours after fractional x irradiation, the total glycogen content and glycogen-protein fraction increased while G-1-P decreased. Fractional neutral irradiation decreased the total glycogen content, glycogen-lipid and, to some extent, protein fractions, and G-1-P and G-6-P contents. Similar investigations of adrenalectomized animals and the same animals given hydrocortisone and epinephrine confirmed the existence of a relationship between the response to irradiation and the content of adrenocortical hormones. They also showed that the mechanism of the biological action of radiation is fairly complex. (Referativnyi Zh.)

27171 RADIOTHERAPY OF A MOUSE MAMMARY CARCINOMA FOLLOWING TREATMENT WITH 5-IODO-2'-DEOXYURIDINE. Stone, H. B. (Univ. of Texas, Houston). Radiology; 112: No. 3, 719-725(Sep 1974).

The radiation response of a C3H mouse mammary carcinoma was determined following a course of six injections of 5-iodo-2'-deoxyuridine (IUdR). The radiation dose to control the tumor in 50% of the animals, the TCD_{50}, was reduced from the control value of 6660 rads to 5900, 5610, 5880, 5740 and 6120 rads at 8, 24, 48, 72, and 120 hours, respectively, after the last IUdR injection. Estimates indicated that 50 to 75% of the total cell population of the tumor was killed by the drug treatment, accounting for part, but not all, of the reduction in TCD_{50}; the remainder was presumably due to sensitization of cells in the hypoxic compartment. (auth)

27172 CONDITIONED SUPPRESSION OF MOUSE KILLING IN RATS FOLLOWING RADIATION OR LITHIUM CHLORIDE INJECTIONS. O'Boyle, M. Tallahassee, FL; Florida State Univ. (1974). 86p. University Microfilms Order No. 74-18,081.

Thesis (Ph. D.).

The conditioned suppression of mouse killing in rats by means of radiation and lithium chloride was investigated in a series of experiments. In experiment one, conditioned suppression of mouse killing was produced following pairings of mouse presentations (CS) with 96 roentgens of ionizing radiation (US) at 0 (2 min) and 30 min US-CS interstimulus intervals. No suppression was found at CS-US intervals of 30 min, 1 hr, and 2 hr; or at US-CS intervals of 1 hr and 2 hr. In experiment two, rats received CS-US pairings of mice and ionizing radiation (CS-US interval 2 min). Although rats that had been familiarized with mice prior to conditioning were less likely to show a suppression of killing than were rats irradiated after their first kill, the result was not statistically significant. In experiment three, injections of LiCl immediately following a kill suppressed mouse killing in rats that had shown no suppression following irradiation treatments in experiment one. The LiCl dose used was the same as that previously used to produce conditioned taste aversions in rats. The results were compared with prior work dealing with conditioned taste aversions, and discussed in relation to: the predatory nature of the rats' killing response and, the idea that there exist biological contraints on learning. (Diss. Abstr. Int., B)

27173 CROSS-SENSITIVITIES OF X RADIATION AND UV LIGHT OF TWO STRAINS OF MURINE LYMPHOMA L5178Y CELLS IN VITRO. Beer, J. Z.; Szumiel, I.; Walicka, M. (Inst. of Nuclear Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Biol.; 21: No. 12, 837-840(Dec 1973).

The 254 nm uv-light and 200 kV x-ray dose-survival relationships were determined for two strains of murine leukemic lymphoblasts L5178Y. Mean lethal doses were 54 erg·mm^{-2} and 100 rads for L5178Y-R cells and 85 erg·mm^{-2} and 54 rads for L5178Y-S cells. Split-dose experiments showed that dose fractionation produces sparing effects for uv-exposed L5178Y-S cells and for x-irradiated L5178Y-R cells. Dose fractionation caused marked reduction of relative survivals in the case of uv-exposed L5178Y-R cells and x-irradiated L5178Y-S cells. (auth)

27174 THE APPLICATION OF MICRODOSIMETRY BY EXAMPLE OF THE 3.5 DAYS-EFFECT IN CHICK EMBRYOS. Doehren, F. R. V. (Mainz Univ. (F. R. Germany). Inst. Fuer Biochemie). Strahlentherapie; 147: No. 5, 544-546(May 1974). (In German).

1 fig.; 7 refs.

Under defined conditions, the minimum size of the reacting biological units can be concluded from the microdosimetric data. In two-days-old chick embryos the order of magnitude of the sensitive units of 2μ corresponds well with the nuclear diameter. (auth)

27175 ENTERAL SODIUM AND FLUID TRANSPORT BEFORE AND AFTER RADIATION EXPOSURE. Physiological Investigations on the Intestine of Awake Rats. P. 1: Upper Small Intestine. Herzer, R. (Tuebingen Univ. (F. R. Germany). Medizinisches Strahleninstitut und Roentgenabteilung). Strahlentherapie; 147: No. 5, 531-543(May 1974). (In German).

2 figs.; 3 tabs.; 30 refs.

Under the application of a special examination technique (extracorporeal perfusion of the intestine of awake, non-narcotized rats) the behavior of the net transport of sodium and water under the influence of ionizing radiation was investigated on the upper small intestine. The experiments were made after different radiation doses (500 and 1,000 r), various intervals after exposure (12 to 16 and 36 to 40 hours) as well as with various osmolar fluids for the perfusion (water, 0.9%, and 1.8% salt solutions). The net-volume transport measured under these conditions showed a marked decrease of the normal, physiological resorption and secretion rates, which mainly developed by steps, in relation to radiation dose and interval. Generally, the measured values had the tendency to move to the zero-mark, or to a stagnation of transport. The net transport of sodium simultaneously showed an adequate reduction or reversion (hypertonic condition) of the normal control values. The statistic examination of the isolated influence of dose and interval and their reciprocity showed a predominance of the time factor, in contrast to the dose, at least in the hypo- and isotonic range. The results are discussed and compared to the few findings known from literature. (auth)

27176 INVESTIGATIONS ON THE CYTOCHROME OXIDASE ACTIVITY OF VARIOUS RAT ORGANS AFTER 200 RAD ^{60}Co TOTAL-BODY IRRADIATION. Krompecher, T.; Krompecher-Kiss, E.; Jona, G. (Lausanne Univ. (Switzerland). Inst. de Pathologie; Debreceni Orvostudomanyi Egyetem (Hungary). Gerichtsmedizinisches Inst.; Debreceni Orvostudomanyi Egyetem (Hungary). Anatomiai, Szoevet es Fejloedestani Intezet Dote; Debreceni Orvostudomanyi Egyetem (Hungary). Radiologisches Inst.). Strahlentherapie; 147: No. 4, 432-436(Apr 1974). (In German).

A number of rats were treated with 200 rad ^{60}Co whole-body irradiation and the cytochrome oxidase activity of their brains, hearts, livers, kidneys, spleens, and jejuna was biochemically determined at intervals of $\frac{1}{2}$, 1, 6, 24, and 48 hours after irradiation. The maximum of change was observed 1 hour p.i., at which time the activity of the heart, kidney, liver, and jejunum declines considerably, whereas the activity of the spleen and brain presents a marked increase. A significant restitution tendency can

be observed after only 6 hours, and after 24 or 48 hours the control data were almost reached, with the exception of the jejunum, which displays but a low restitution activity. (auth)

27177 PREVENTION OF THE CONSEQUENCES OF IRRADIATION BY MEANS OF TRANSPLANTATION OF SYNGENIC BONE MARROW STORED AT A TEMPERATURE OF −196°C. Daszynski, J.; Kotelba-Witkowska, B.; Klenowska, Z.; Moscicka, M. (Inst. Hematology, Warsaw). Acta Haematol.; 5: No. 1, 35-42(1974). (In Polish).

A method is described for obtaining bone marrow from mice and storage of this marrow at a temperature of −196°C using glycerol and DMSO as cryoprotective agents. The effect of storage at low temperatures on quantitative recovery of bone marrow cells and its effectiveness in prevention of radiation sickness were assessed in vitro and in vivo. (auth)

27178 EFFECT OF CERTAIN RADIOPROTECTIVE COMPOUNDS ON POSTRADIATION SODIUM EXCHANGE. Drozd, S. S.; Burlakova, E. V.; Burdin, K. S. (Moscow State Univ.). Biol. Nauki; No. 2, 47-51(1974). (In Russian).

The distribution of radioactive sodium in the livers of irradiated mice given radioprophylactic compounds 15 minutes before irradiation was compared with that of untreated controls. The radioprotective compounds used were S, beta-aminoethylisothiuronium (AET), which has antioxidative properties, and pyridine, N-hydroxypyridine, and N-hydroxy-2, 6-lutidine, which are not antioxidative. Tissue samples were prepared for liquid scintillation counting by KOH solubilization; methanol was added with the scintillation fluid. Chemiluminescence interference was minimized by maintaining the samples in the closed counter for one year before counting. It was found that the protective compounds initially increased the amount of ^{22}Na in the livers, but after about 120 hours the radioactivity began to decrease as compared to controls. This is explained by the fact that these compounds also increase ^{22}Na accumulation in unirradiated mouse livers for the first 24 hours. The order of effectiveness in both processes is AET best, then N-hydroxpyridine, then pyridine, and N-hydroxy-2, 6-lutidine least. Mixtures of AET with the others gave a cumulative effect. The data indicate that changes of both the oxidative and nonoxidative types occur in the cell membrane under irradiation. (JPRS)

27179 CHANGE OF HEPATIC FUNCTION DURING DEVELOPMENT OF A SUBCUTANEOUS ABSCESS AND IN IRRADIATION OF THE ABDOMINAL AREA IN RABBITS. Gileva, T. P.; Sveshnikov, A. A.; Bandurko, L. N. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Patol. Fiziol. Eksp. Ter.; 17: 27-31(1973). (In Russian).

Unitypical disturbances of hepatic function followed the actions under study. From the first day of development of the turpentine-induced inflammation there occurred a change in the blood protein composition, from the 3rd to the 7th day the excretory function proved to be disturbed, and on the 7th day there ensued a derangement of the secretory function of the liver. Gamma irradiation of the abdominal area (excluding the area of the liver) in a dose of 1600 rad caused a disturbance of protein, antitoxic, and secretory function of the liver. With elevation of the dose to 2500 and 3200 rad there was an increase in intensity and duration of the changes of these functions and a disturbance of secretory function. Hepatic functions under study were normalized more rapidly than its structure. Thus, the appearance of functional and morphological disturbances of the liver could take place with development of various extrahepatic pathological processes. (auth)

27180 EFFECT OF PREDNISOLONE ON THE FORMATION OF HEMOPOIETIC COLONIES IN THE SPLEEN OF MICE FOLLOWING SUBLETHAL IRRADIATION. Rudakova, T. L.; Babinina, V. F. Patol. Fiziol. Eksp. Ter.; 17: 37-40(1973). (In Russian).

A method of endogenous splenic colonies was applied to the study of the effect of prednisolone on the activity of stem hemopoietic cells in the spleen of $C_{57}Br$ mice following sublethal irradiation. The total number of hemopoietic colonies both on the surface of the spleen and their count in histological preparations increased under the effect of prednisolone; the number of erythroid and megakariocytic cellular accumulations increased in particular. It is likely that prednisolone influenced not only the activity of colony-forming cells (stem), but also the direction of their differentiation. (auth)

27181 THYMUS GLAND IN RADIATION STUDIES WITH PARTICULAR REFERENCE TO THYMOCYTE ULTRASTRUCTURE. Wozniewicz, B. (Zaklad Anatomii Patologicznej, Warsaw). Patol. Pol.; 24: 197-201(1973). (In Polish).

The author's work for the period 1967 to 1970, was summarized for the 9th Congress of the European Society of Radiation Biology, Sept. 26-28, 1972, in Rzymie.

27182 EFFECT OF TOTAL X RADIATION ON CONDITIONED REFLEX ACTIVITY IN RATS OF OLD AGE. Kharchenko, P. D.; Elmuratov, S.; Chaichenko, G. M. (State Univ., Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR; 22: No. 4, 472-478(1974). (In Ukrainian).

The experiments were performed on albino male rats at the age of 6 months. The x irradiation in doses of 500, 600, and 700 R evoked considerable changes in the conditioned reflex activity of the rats which manifested in prolongation of the latent period and the reaction duration in an increase in the reflex intensity and intersignal reactions as well as in a release of the differential inhibition. These changes were of pronounced phase character. With large doses of the irradiation three phases were observed in the rat activity decrease: phase I−the first to fourth day, phase II−the 14 to 18th day, phase III−the 19th to 22nd day after irradiation. The higher the radiation dose, the greater the effect of the action. (auth)

27183 SEASONAL PERIODICITY OF PROTEIN METABOLISM IN THE CELLS OF THE LIVER AND FOOT EPITHELIUM IN NON-IRRADIATED AND IRRADIATED RATS. Chekulaeva, L. I.; Bulgak, V. I. (Inst. for Experimental Medicine, Leningrad). Tsitologiya; 16: No. 7, 863-867(Jul 1974). (In Russian).

In winter and summer periods of the year characterized by different light duration of the day, seasonal changes of the total protein metabolism were studied by the radioautographic method with ^{35}S-methionine in the cells of the liver and sole epidermis in nonirradiated and irradiated rats. The curves showing the diurnal periodicity of the protein metabolism in the cells under study were of one-peak character. Shift of the maximum level of the protein metabolism depending on the light regimen of the day in various seasons, was revealed. Mean values of methionine incorporation into the cells of the liver and epidermis for 24 hrs were shown to be higher in irradiated rats as compared with non-irradiated. (auth)

27184 SYNKAVIT: RADIOSENSITIZING AGENT IN PROSTATIC CARCINOMA. Halsall, G. M.; Connolly, J. G.; Mobbs, B. G.; Promislow, C. (Univ. of Toronto). Urology (N. Y.); 1: No. 6, 550-552(Jun 1973).

Six male cynomolgus monkeys were intravenously injected with 10 microcuries per pound of tritiated synkavit and 0.67 mg. per pound of carrier synkavit. Two animals were sacrificed at fifteen minutes, two at thirty minutes, and two at one hour after injection. Samples of caudal prostate bladder, testis, spleen, liver, lung, upper and lower intestines, skin, muscle, fat, urine, and serum were removed. At fifteen minutes the concentration of menadione in the prostate gland was 2.26×10^{-6} M, which is more than that found in any other tissue. This level is sufficient for radiosensitization. (auth)

27185 IMMUNOLOGIC REACTIVITY IN CANINE MARROW GRAFT RECIPIENTS. Ochs, H. D.; Storb, R.; Thomas, E. D.; Kolb, H. J.; Graham, T. C.; Mickelson, E.; Parr, M.; Rudolph, R. H. (Univ. of Washington, Seattle). J. Immunol.; 113: No. 3, 1039-1057(Sep 1974).

Immune reactivity was studied in 55 dogs between 20 days and 8 years after lethal total body irradiation (TBI) or cyclophosphamide (CY) and grafting of autologous or allogeneic marrow. This was compared to findings in 50 normal dogs. Cytogenetic and other blood genetic markers showed that the hemopoietic and lymphoid systems in allogeneic chimeras conditioned by TBI were repopulated only by cells of donor type. In contrast CY chimeras showed persisting mixtures of host and donor cells. Recovery of granulocyte counts and return of granulocyte function as determined by iodination tests were complete by day 25 after grafting. Blood lymphocyte counts did not reach the normal range until day 200. Lymph node histology showed lymphoid hypoplasia for 100 to 200 days and returned to normal thereafter. Short-term chimeras (<200 days postgrafting) had slightly lower and long-term chimeras (>200 days postgrafting) had significantly higher serum IgG level than did normal dogs. Antibody formation to chicken red blood cells and sheep red blood cells and bacteriophage ϕX174 (phage) was lower than normal in the first 200 days and within the normal range thereafter. The class of antibody after repeated immunization was predominantly IgM in short-term and predominantly IgG in long-term chimeras and in normal dogs. Phage clearance was normal in all chimeras. Transfer of immunity to distemper and phage was studied with equivocal results. Cellular immunity (first and second set skin grafts, stimulation of lymphocytes in mixed leukocyte culture and by phytohemagglutinin) was impaired in short-term chimeras and normal in

long-term chimeras. An exception was the tuberculin conversion after Bacille Calmette-Guerin immunization which occurred as early as day 29. As a clinical correlate to these studies on immune function, long-term chimeras regained their health and are able to live in an unprotected environment without increased susceptibility to infections or other diseases. (auth)

27186 INCREASED BRAIN RADIORESISTANCE AFTER SUPRALETHAL IRRADIATION. Chaput, R.L.; Berardo, P.A. (Radiobiology Department, Armed Forces Radiobiology Research Institute, Bethesda, Maryland 20014). Med. Phys. 1: No. 3, 148-151 (1 May 1974).

Clinical symptoms and performance were evaluated after shuttlebox-trained miniature pigs received two 4400-rad doses separated by time intervals of 10^{-4}-30 min. The doses were delivered to the head by 45-MeV electrons from the AFRRI electron linear accelerator (LINAC). There was no significant difference in neurological symptons (convulsions, coma, ataxia) or in performance after the second dose between animals that received the two doses 10^{-4} or 0.3 min apart. As the time interval between doses was increased from 0.3 min, however, neurological symptoms declined and performance improved markedly after the second dose. When the doses were 30 min apart, the pigs showed no decrease in performance within the initial 30-min postirradiation. It was concluded that more than physiochemical processes were involved in the increased radioresistance to the second dose of radiation. (auth)

27187 MAINTENANCE OF OPTIMUM CYSTEAMINE BLOOD CONCENTRATION BY MEANS OF POLY(VINYL ALCOHOL) THIXOTROPIC GEL. Pantev, T. Rentgenol. Radiol.; 12: No. 3, 165-170(1973).

An inadequacy of most radioprotectors is their quite short period of action (30 to 60 minutes), after which their protective effect sharply falls. With a view to obtaining a radioprotective preparation with a prolonged time of action a poly(vinyl alcohol) gel of cysteamine has been prepared. Its capability of maintaining the needed cysteamine concentration in the blood within a continuous period of time was studied on rats. It was established that the optimum blood concentration of cysteamine is reached about two hours after application of the poly(vinyl alcohol) gel and is maintained in the course of four hours. By combined application of maximum tolerable doses of cysteamine and poly(vinyl alcohol) thixotropic cysteamine gel the concentration of the radioprotector is maintained from the 30th minute to the 6th hour. Whether the respective protective effect will be observed long enough after maintenance of the blood cysteamine concentration is a problem to be established after a radiobiological experiment. (Abstr. Bulg. Sci. Med. Lit.)

27188 MEDICAL PRIMATOLOGY 1972. Part II. Experimental Surgery, Transplantation Immunology, Oral Medicine, and Neurophysiology and Experimental Psychology. Third Conference on Experimental Medicine and Surgery in Primates, Lyon, France, June 21-23, 1972. Goldsmith, E. I.; Moor-Jankowski, J. (eds.). Basel; S. Karger AG (1972). 366p. (CONF-7206103-P2). $37.20.

A separate abstract was prepared for one of the 143 papers included. Other papers discuss experimental surgery, transplantation immunology, oral medicine, neurophysiology, the breeding of laboratory animals, genetics, evolution, reproduction, perinatal studies, infectious diseases, viral oncology, cardiovascular studies, and pharmacology and toxicology. (CH)

For an abstract of an individual paper see: 27189.

27189 BONE MARROW TRANSPLANTATION IN RHESUS MONKEYS. Methods to Mitigate the Acute Graft Versus Host Disease. Schaefer, U. W.; Dicke, K. A.; van Bekkum, D. W. (Radiobiological Inst. TNO, Rijswijk, Norway). pp 142-148 of Medical Primatology 1972. Part II. Goldsmith, E. I. (ed.). Basel; S. Karger AG (1972).

From third conference on experimental medicine and surgery in primates; Lyon, France (Jun 1972). See CONF-7206103-P2.

Lethally irradiated monkeys (macaca mulatto) transplanted with frozen allogenic bone marrow cell grafts showed a recovery of hemopoiesis. Methods are described that were used for the separation of hemopoietic stem cells from immunocompetent lymphocytes in bone marrow samples, in vitro testing of the proliferation capacity of stem cells by a cell culture technique, the preparation of frozen bone marrow cells for storage, and the prior- and post-injection treatment of recipients for the mitigation of graft versus host reactions. (CH)

27190 ABROGATION OF RESISTANCE TO BONE MARROW GRAFTS BY SILICA PARTICLES. Prevention of the Silica Effect by the Macrophage Stabilizer Poly-2-Vinylpyridine-N-Oxide. Lotzova, E.; Cudkowicz, G. (State Univ. of New York, Buffalo). J. Immunol.; 113: No. 3, 798-803(Sep 1974).

An attempt was made to assess the role of macrophages in resistance of irradiated mice to parental-strain and allogeneic bone marrow grafts. 1.25 to 5 mg of silica particles injected i. v. (5 μ average size) are specifically toxic to macrophages and resulted in prompt abrogation or reduction of hybrid and allogeneic resistance. The silica was equally effective when given within 2 days before or after transplantation of bone marrow cells. The effectiveness decreased with increasing intervals, but foreign marrow cells could be rescued from rejection as long as 3 days after grafting. The macrophage stabilizer poly-2-vinylpyridine N-oxide injected subcutaneously (150 mg/kg) 1 day before silica entirely prevented the suppression of hybrid resistance. It was concluded that macrophages, or a subpopulation thereof, could be the effectors of hemopoietic graft rejection by irradiated mice. The immunogenetic specificity of these allograft reactions and the suppressive effects of anti-lymphocyte agents suggest, however, that also lymphoid cells participate in this process. (auth)

27191 EFFECT OF REPEATED DOSES OF X RAYS OR 14 MeV NEUTRONS ON MOUSE BONE MARROW. Hendry, J. H.; Testa, N. G.; Lajtha, L. G. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Radiat. Res.; 59: No. 3, 645-652(Sep 1974).

Repeated x-irradiation (4 × 450 rads) of mice produces a decreased rate of bone marrow regeneration to a suboptimal level, compared to that after a single dose of 450 rads. 14 MeV neutrons are more effective in producing this reduced level by a factor of 1.7-1.8. The irradiated host (single 850 rads or 4 × 450 rads x-rays) is responsible for a lower growth rate of colony-forming units. The suboptimal plateau however is a cellular effect, and these are additive during endogenous repopulation. A host effect is not demonstrable in terms of changes in the colony-stimulating activity of the femur shaft in bone marrow cultures. (auth)

27192 LYSOSOMAL ENZYMES IN ORGANS OF IRRADIATED RATS. Kocmierska-Grodzka, D.; Gerber, G. B. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium). Dept. de Radiobiologie). Strahlentherapie; 147: No. 3, 271-277(Mar 1974).

4 tabs.; 33 refs.

Acid phosphatase, β-glucuronidase and cathespin B were assayed in duodenum, lung, ileum, brain, and urine (in the latter, only β-glucuronidase and acid phosphatase) of fed, starved and whole-body irradiated rats (1 and 2 days after 500 and 2,000 R). An increase in lysosomal activity was found in ileum and duodenum particularly on day 1 and in the high dose range. β-glucuronidase displays the most pronounced increase. In normal brain, only low catheptic activity is found, and changes are small. In lung, an increase in β-glucuronidase is noted one day after 2,000 R. (auth)

27193 ANGIOGRAPHIC EXAMINATIONS OF THE PORTAL LIVER VESSELS OF RABBITS AFTER RADIATION INSULT. Brase, A.; Bockslaff, H.; Emminger, E. (Medizinische Hochschule Hannover (F.R. Germany). Inst. fuer Klinische Radiologie; Medizinische Hochschule Hannover (F.R. Germany). Abt. fuer Experimentelle Pathologie). Strahlentherapie; 147: No. 3, 278-289(Mar 1974). (In German).

22 figs.; 39 refs.

In an animal experiment on New Zealand rabbits radioinduced damages on the vessels of the portal system were found by operative portography. After a short observation period, in the animals characteristic, dose-depending morphological alterations, variations in caliber and vascular stops in the small and medium branches of the portal vein were seen; alterations of the same kind are described by other authors as symptoms of acute and subacute hepatitis in man. After long-term observation during 4 months no symptoms for progression of the pathological vascular changes were found; on the contrary, a partial restoration of the vascular damages was objectivated. The changes in the portogram were completed by histological examinations. (auth)

27194 THE ACTION OF CERTAIN DRUGS ON THE IMMEDIATE CONTRACTILE RESPONSE OF ISOLATED GUINEA-PIG DETRUSOR MUSCLE TO X-IRRADIATION. Michailov, M. C.; Kuemper, H. J.; Welscher, U. E. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F.R. Germany). Inst. fuer Biologie; Muenchen Univ. (F.R. Germany). 2. Frauenklinik). Strahlentherapie; 147: No. 3, 290-297(Mar 1974).

4 figs.; 23 refs.

The action of different cholinergic (acetylcholine, physostigmine, atropine, etc.), alpha- and beta-adrenergic (noradrenaline, isoprenaline- propranolol, etc.), ganglion blocking and "neurotropic" (bretylium, tetrodotoxin, hemicholinium, etc.) and other drugs on the immediate contractile response of guinea-pig detrusor muscle

to x-irradiation was investigated. The X-ray reaction of the detrusor muscle was concluded to be myogenic and not of neurogenic origin, and the participation of cholinergic and/or adrenergic mechanisms in this reaction seems to be excluded. (auth)

27195 ULTRASTRUCTURE OF IRRADIATED NUCLEI. Klein-Szanto, A. J. P.; Rey, B. L. M. de; Conti, C. J.; Cabrini, R. L. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Departamento de Radiobiologia). Strahlentherapie; 147: No. 3, 263-270(Mar 1974).

10 figs.; 40 refs.

Ultramorphologic nuclear features of irradiated epidermis, cartilage, and BHK cells were studied during the first (1 to 8) days after irradiation following a single dose of 5,000 rad of X-irradiation, until clear necrotic phenomena were noted. The nuclear alterations appeared successively in these tissues, first as reactive changes represented by hypertrophy of nuclei and nucleoli, nuclear inclusions, pseudoinclusions, and lobulation. These changes were followed by involutional alterations, mainly, chromatine clumping, nuclear dissolution, myeloid body formation, and nuclear fragmentation. The ultrastructural findings were similar in the three tissues, although the timing of these lesions was not the same. This difference in the sequence of appearance could be related with the diverse radiosensitivity of the tissues, the different cell renewal rates, and with the different oxygen tension of cartilage, BHK and epidermal cells. (auth)

27196 INVESTIGATIONS TO THE PROLIFERATION KINETICS IN THE RAT KIDNEY AFTER X-RAY TREATMENT AND/OR NEPHRECTOMY. P. 1. ^{3}H-Activity Measuring. Eckel, H. (Medizinische Hochschule Hannover (F.R. Germany). Inst. fuer Klinische Radiologie); Emminger, A. (Medizinische Hochschule Hannover (F.R. Germany). Abt. fuer Experimentelle Pathologie). Strahlentherapie; 147: No. 3, 254-257(Mar 1974). (In German).

3 figs.; 7 refs.

In 150 female Sprague-Dawley rats the proliferation kinetics of the kidney were examined by ^{3}H-activity measurement during 7 to 70 days, after local radiotherapy and/or nephrectomy. Hereby exact terms of minimum and maximum tissue proliferation were objectivated in the irradiated kidneys. Moreover, it was demonstrated that histological lesions by different radiation doses are answered by regenerative processes, whose degree only varies in dependence on the different intensity of the noxa. (auth)

27197 EXPERIMENTS ON THE RADIOSENSITIZATION OF THE INDUCTION OF TRYPTOPHAN PYRROLASE AND TYROSINE AMINOTRANSFERASE IN THE LIVER OF MICE (5-BROMODEOXYURIDINE AND REGENERATING LIVER). Schweiger, K. H. Freiburg, Ger.; Freiburg Univ. (1973). 92p. (In German). INIS.

Thesis. 25 figs.; 81 refs. With abstract. Available from the Freiburg Univ. library.

Female mice aged about 8 weeks were partially hepatectomized and exposed to whole-body irradiation with x rays. At certain times after hepatectomy and prior to killing, the animals were injected with 280 ωCi/kg of ^{3}H-thymidine, ^{3}H-deoxyadeonosine, ^{3}H-BUdR, and ^{3}H-IUdR. The remaining liver was removed after decapitation of the mice for determining the content of DNA and RNA, the incorporation of ^{3}H-labelled nucleotides, the enzyme activities, the ^{3}H-labelled pyridine metabolites and the content of proteins. DNA synthesis in the regenerating liver started 24 h p.o. and reached its maximum between 48 and 63 h p.o. It was not inhibited by BUdR, IUdR, or FUdR. Simultaneous injection of deoxyadenosine and BUdR or FUdR was found to result in an enhancement of the incorporation of deoxyadenosine by 30% and 100%, respectively. Incorporation of BUdR into the DNA was linear up to 60 min p.i. but is rapidly decomposed in the mammalian organism. A combination of BUdR with 5-FU and 5-FUdR produced no increase in BUdR incorporation into the DNA. The activities of the two enzymes were not essentially enhanced but could always be induced at a maximum. The induction process of the tryptophan pyrrolase showed constant, relatively high radiosensitivity, whereas the induction of the soluble cytoplasma fraction of the tyrosine aminotransferase was less sensitive and could only be affected by higher radiation doses. The mitochondria fraction was most sensitive at the end of the first regeneration cycle. It could not be established with certainty whether the incorporation of BUdR enhanced the radiosensibility of the induction process. The induction of the tryptophan pyrrolase was clearly sensitized. (GE)

Invertebrates

27198 SEARCH FOR RADIORESISTANCE IN EXPERIMENTAL POPULATIONS OF DROSOPHILA WITH RADIATION HISTORIES. Sankaranarayanan, K. (State Univ. of Leiden). Mutat. Res.; 24: No. 2, 213-217(Aug 1974).

Results are given of a search for radioresistance in two irradiated populations of Drosophila melanogaster. The two populations received 2000 R of x rays under anoxia and either nitrogen or oxygen post-treatments in every generation for 64 generations. Radiosensitivity differences in 6 subsequent generations were determined by measuring dominant lethal mutation rates. The results revealed that there was considerable variation among the different populations and within populations tested. It was concluded that the populations do not manifest any systematic and significant differences between them. The result was not entirely unexpected since the mutation required to demonstrate this property is extremely rare. (ERB)

27199 RADIATION-INDUCED DOMINANT LETHALITY IN OOCYTES OF DROSOPHILA HYDEI, WITH EMPHASIS ON THE DIFFERENTIAL SENSITIVITY OF THE IMMATURE STAGES IN CLASS B. Frei, H. (Laboratoire de Genetique Animale et Vegetale, Geneva). Mutat. Res.; 24: No. 2, 125-134(Aug 1974).

A brood-pattern analysis of radiation-induced damage in the oocytes of attached-X females of Drosophila hydei was carried out by the dominant lethal test. The methods used allow a refined description of the differential radiosensitivity of oocytes with respect to the stage succession in the oogenesis of this species. As in D. melanogaster, three levels of sensitivity, corresponding to classes A, B, and C of oocytes, showed up. The differences in sensitivity led to clear-cut steps in the brood pattern of lethal frequencies, whereby class B is distinguished by an intermediate yield of induced damage. Eggs deposited on the first day after irradiation are not in every instance a pure sample of irradiated stage-14 oocytes, but may contain an admixture derived from less sensitive vitellogenic stages. For the previtellogenic stages, belonging to class B, it is proposed that it is the youngest group which exhibits the highest radiosensitivity. This agrees with earlier results from detachment of attached-X chromosomes in D. hydei. The brood patterns of lethal frequencies were not identical, but similar, when a distinction was made between induced early and late embryonic lethality. On certain assumptions, this is interpreted to mean that the stage-dependent differences in sensitivity observed are due to genetic causes, i.e., are correlated with changes in the state of the oocyte nucleus during oogenesis. (auth)

27200 NATURE AND TIME OF OCCURRENCE OF RADIATION-INDUCED NONDISJUNCTION OF THE ACROCENTRIC X AND FOURTH CHROMOSOMES IN DROSOPHILA MELANOGASTER FEMALES. Parker, D. R. (Univ. of California, Riverside); Williamson, J. H.; Gavin, J. Mutat. Res.; 24: No. 2, 135-148 (Aug 1974).

Radiation-induced nondisjunction in Drosophila melanogaster females usually – possibly invariably – involves the participation of chromosomes other than the pair in which the numerical aberration is noted, with one of the two acrocentric pairs frequently being involved in the assortative error of the other. Nearly one-half of all diplo-X eggs produced following the irradiation of immature oocytes of females having free X's are found to be nullo-4, and, in agreement with earlier reports, about one-fourth of all nullo-X eggs are diplo-4. The incidence of structural alterations is markedly higher in chromosomes involved in nondisjunctions than in those recovered from normal segregations, with the structural changes being those expected from interchange between X and fourth chromosomes where only one of the two interchange products (a "half-translocation") is recovered. X chromosomes may acquire an arm of chromosome 4, and fourth chromosomes may lose the marker from the left arm, as if the short, heterochromatic right arm of the X had been substituted. Homozygosis of markers near the centromere of the X chromosome shows that nearly all failures of segregation must occur at division I. While the data do not require that there be some division II nondisjunction, neither do they categorically deny the possibility of its occurring at a very low level. The findings are as expected on the model of heterologous conjunction via chromatid interchange as the major and perhaps exclusive cause of radiation-induced nondisjunction. (auth)

27201 RADIATION-INDUCED NONDISJUNCTION AND ROBERTSONIAN TRANSLOCATION IN DROSOPHILA. Parker, D. R. (State Univ. of Leiden). Mutat. Res.; 24: No. 2, 149-162(Aug 1974).

In Drosophila melanogaster, gametes formed by oocytes in which Robertsonian translocations were induced in an immature stage usually show chromosomal imbalance. It is estimated that fewer than 20% of the gametes bearing newly induced Robertsonian translocations "fusing" X and fourth chromosomes are of balanced constitution. In contrast, when the two acrocentric pairs,

X and fourth chromosomes, are replaced by an X-4 Robertsonian translocation, treatment of immature oocytes of homozygotes produces some 5 to 6-fold fewer sex-chromosome trisomics than do females of normal karyotype. In the place of such trisomics (having separate sex chromosomes), there is a much smaller number of compound-X chromosomes formed and a number of compound-fourth chromosomes as well. However, the production of "XO" males is not appreciably smaller in the translocation homozygotes. A number of possible mechanisms to account for this are suggested. The findings are consistent with the expectations of the hypothesis that radiation-induced nondisjunction results from improper conjunctions of heterologues, brought about by chromatid interchange. (auth)

27202 EFFECTS OF STRUCTURAL HETEROZYGOSITY ON THE RECOVERY OF AUTOSOMAL (II-III) TRANSLOCATIONS FROM X-IRRADIATED MATURE AND IMMATURE OOCYTES OF DROSOPHILA MELANOGASTER. Sankaranarayanan, K. (Leiden State Univ.). Mutat. Res.; 24: No. 3, 389-393(Sep 1974).

A study was conducted to determine whether irradiation of females heterozygous for multiply-inverted second and third chromosomes would result in a response different from that obtained with structurally normal females. The results suggest that in stage 7 (immature) oocytes there may be a difference whereas stage 14 (mature) oocytes this is not the case. The low absolute frequency of translocations recovered from stage 7 oocytes is consistent with the model of directed disjunction and the thesis that the rarity of recovery of reciprocal translocations is primarily a consequence of segregation and not due to lack of induction. (ERB)

27203 X-RAY INDUCTION OF DOMINANT LETHALS IN LATE SPERMATIDS AND MATURE SPERMATOZOA OF DROSOPHILA MELANOGASTER: THE ROLE OF OXYGENATION. Sankaranarayanan, K. (State Univ., Leiden). Mutat. Res.; 24: No. 3, 307-316(Sep 1974).

The role of oxygenation in determining the sensitivity to the induction of dominant lethals was examined in late spermatids and mature spermatozoa of Drosophila melanogaster. 0 to 2-h-old or 7-day-old Oregon-K males were irradiated with different x-ray exposures in nitrogen, air, or in oxygen and the frequencies of dominant lethals induced in these stages were studied. The results obtained confirm and extend Sobels' earlier observations and the interpretation derived therefrom namely, that under normal conditions in air, mature spermatozoa are characterized by a higher degree of oxygenation than late spermatids and this difference is sufficient to explain the differential response of these stages. Similar Oxygen-Enhancement-Ratios (OERs) (of about 2) were obtained for both the cell stages. The present data also revealed that late spermatids are significantly less sensitive than mature spermatozoa to the x-ray-induction of dominant lethals in a nitrogen atmosphere. A plausible mechanism is suggested to explain this observation. (auth)

27204 SOME BIOLOGICAL AND HISTOPATHOLOGICAL EFFECTS OF GAMMA RADIATION ON THE GONADS OF THE ORIENTAL FRUIT FLY, DACUS DORSALIS HENDEL. Manoto, E. C. Honolulu, HI; Univ. of Hawaii (1973). 138p. University Microfilms Order No. 74-17,213.

Thesis (Ph. D.).

The feasibility of utilizing radiation sterilization for the control of the Oriental fruit fly, Dacus dorsalis Hendel, was the general consideration of this study. It included a comparison of radiation effects on flies when treated as 8-day-old pupae or as 3-day-old adults. Treatment with 5 or 10 Krad of gamma radiation resulted in an atrophied condition of both testes and ovaries when treated as either pupa or adult. In the testes, such condition was induced by the death of the stem cells, the spermatogonia, and by the degeneration of pycnotic spermatocytes and spermatids and an eventual resorption of testicular contents. Similarly, necrosis of oogonial cells was evident in the ovaries. The radiosensitivity of the male germ cells was dependent upon the stage of cell division. There was no recovery in both spermatogenesis and oogenesis even at 44 days after treatment of either pupae or adults irradiated with 5 or 10 Krad. This result indicated that sterility in both males and females was permanent. Radiation reduced the amount of sperm transferred by 15-day-old male treated with 10 Krad during the pupal stage. This was possibly a consequence of death of spermatogonial cells resulting in aspermia. However, males irradiated during the adult stage and those irradiated with 5 Krad at either stage were able to transfer sperm longer than those treated with 10 Krad during pupal stage. Studies evaluating mating performance of male flies indicated that both treated and non-treated males in a 3 : 1 ratio, except those treated with 10 Krad in the pupal stage, competed with equal success with normal females. Irradiation reduced fertility of eggs laid by females mated with treated males. A dose of 5 Krad induced about 99.5% dominant lethality among the sperm of testes when flies were treated as late pupae and about 91.9 to 96.7% lethality when males were treated as 3-day-old adults with 5 and 10 Krad, respectively. (Diss. Abstr. Int., B)

27205 REPRODUCTION OF OOENCYRTUS KUWANAE HOWARD IN THE KILLED GYPSY MOTH EGGS WITH RADIATION. Bjegovic, P. (Institut za Zastitu Bilja, Belgrade). Zast. Bilja; 23: 117-118(1972).

The egg parasite Ooencyrtus kuwanae How. can be reared all around the year in the killed Gypsy moth eggs with radiation. The eggs have to be stored at about −5°C where they stay until exposure to the radiation and parasitation. The doses of 40, 50, 60, and 70 krad were sufficient to kill the Gypsy moth eggs. (Bull Sci. Sec. A)

27206 TWO RELEASES OF STERILE GYPSY MOTH MALES (LYMANTRIA DISPAR. L.) IN THE PARK OF JELSA ON THE ISLAND OF HVAR. Maksimovic, M. Zast. Bilja; 23: 117-118 (1972).

Releasing irradiated gypsy moth males led to a diminution of healthy eggs and caterpillars. The first generation did not demonstrate this very much, but each following generation showed this to an ever greater extent. It will be necessary to proceed with this irradiation method and with further research work. (Bull. Sci. Sect. A)

Radionuclide Effects (Internal Source)

27207 (CONF-730907-P1, pp 469-474) RECENT TRENDS TOWARDS THE DOSE HAZARD: REFERENCE STANDARDS FOR DIFFERENT RADIONUCLIDE GROUPINGS. Failla, L. (Italian Unification Organization, Rome). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Dose hazards using radionuclides groupings are considered, with a view to the importance of including the nuclide utilization modes in their classification. The problem of giving quantitative values to parameters for the evaluation of dosage risk is analyzed, changing from the concept of curies to the concept of rems, giving IAEA regulations for transportation of radioactive materials as an example. Value of the reference dose is examined, mentioning the priority meter used in Italy in surveillance activities on instruments containing isotopes. (auth)

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Refer also to abstracts 26782, 26793, 26797, 26801, 26803, 26804, 27057–27061, 27070, 27072, 27126, 27148, and 28578–28580.

27208 (CONF-730907-P1, pp 439-447) RADIOSENSITIVITY AND DOSIMETRY OF THE TISSUES OF BONE: IMPLICATIONS FOR SETTING MAXIMUM PERMISSIBLE LEVELS OF BETA EMITTERS. Spiers, F. W. (Univ. of Leeds, Eng.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Calculations are made of the risk to bone from incorporated β emitters, based on calculations of absorbed rates to bone marrow and endosteal tissues for a body burden of 1 μCi. The risk of leukemia is based on human data and that of osteosarcoma and other bone tumors on a comparison of the incidence of these malignancies with the leukemia incidence in animals continuously irradiated by β particles from ingested ^{90}Sr. Maximum permissible body burdens are then derived by a comparison of these risk values with a total risk estimated to correspond with an annual dose of 5 rad to the whole body. (auth)

27209 (CONF-730907-P1, pp 610-618) STATISTICAL APPROACH IN DEVELOPING MATHEMATICAL MODELS FOR EVALUATING INTERNAL IRRADIATION. Bad'in, V. I.; Andronov, S. A.; Ermilov, A. P.; Khrushch, V. T.; Margulis, U. Ya. (Inst. of Biophysics, Moscow). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In order to estimate the accumulation of radioactive substances within the body of personnel from data on air contamination it is

necessary to know aerosol characteristics averaged over human locations during the working shift, with due account for the efficiency of individual protective means. But the necessary qualitative and quantitative data are usually lost when stationary samplers are used. Data are presented on the statistical distribution functions of the radionuclide concentration ratio at the sampling point and the concentration at the respiration zone, protective efficiency of individual protective means, and elimination of the radionuclide from the body. An estimate of the errors for determining an inhalation intake of radioactivity into the body is included. Various techniques for controlling internal radiation exposure are discussed. (CH)

27210 (CONF-730907-P1, pp 625-630) ESTIMATES OF DOSE RATE TO GONADS OF INFANTS AND CHILDREN FROM A PHOTON EMITTER IN VARIOUS ORGANS OF THE BODY. Snyder, W. S. (Oak Ridge National Lab., TN). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radaition Protection Association.

Estimates of dose rates to gonads of infants and children from newborn to 15 years of age from sources of a photon emitter distributed uniformly in various organs of the body are presented. The results are obtained by application of the reciprocity theorem to the Monte Carlo estimates of dose rate from gonads to large organs. Results for photon energies of 0.02, 0.05, 0.1, 0.5, 1, and 2 MeV are reported. The basic phantoms used were essentially modifications of a heterogeneous adult phantom. The modifications include specification of regions where active bone marrow is deposited in the adult, addition of clavicles and scapulae to the skeleton, rounding of the top of the head, separate legs for the phantom, and relocation of the testes. (CH)

27211 (CONF-730907-P1, pp 643-647) TECHNIQUE FOR ESTIMATING THYROID DOSES FROM THE INTAKE OF IODINE-129. Oscarson, E. E. (Environmental Protection Agency, Washington, DC). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Recent concern for the environmental buildup of long-lived radionuclides has suggested that dose estimation techniques should be developed for such nuclides. Iodine-129 is a long-lived radionuclide which has recently been found in low concentrations in milk in the environs around a nuclear fuel reprocessing facility. Thus, there was a need to develop a method for estimating the public health impact, in terms of thyroid dose, resulting from the consumption of this milk. In developing the technique various approaches were considered including specific activity and dietary modeling. It was concluded the most acceptable approach was that using standard man information. The method developed indicates that for the same level of intake, thyroid dose would be only slightly higher from iodine-129 as compared to iodine-131. (auth)

27212 (CONF-730907-P1, pp 713-718) BIOMEDICAL FOLLOW-UP OF THE MANHATTAN PROJECT PLUTONIUM WORKERS. Hampelmann, L. H. (Univ. of Rochester, NY); Langham, W. H.; Voelz, G. L.; Richmond, C. R. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Results are reported from long-term studies performed on 25 men who were exposed to plutonium during World War II at what is now the Los Alamos Scientific Laboratory. Almost all of the subjects had body burdens of plutonium ranging from 0.1 to 1.3 μg or 6 to 80 nCi of relatively pure ^{239}Pu as estimated from the urine assay method for plutonium used at Los Alamos prior to 1950. The war-time exposure conditions are reconstructed. Estimates of body and lung burdens, based primarily on urine assay, during the 20-yr period (1953 to 1972) are presented. Results of medical studies that have continued during these years are reported. (CH)

27213 (CONF-730907-P1, pp 736-742) TOXICOLOGY OF TRANSPORTABLE URANIUM: A CRITICAL CONTRIBUTION TO HEALTH PROTECTION OF WORKERS. Breuer, F.; Righi, E. (CNEN, Rome). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The chemical toxicity of uranium has a remarkable importance in the evaluation of the risk of internal contamination due to transportable compounds of such element. The risk becomes most relevant when one has to deal with natural uranium or long-lived uranium isotopes (^{235}U and ^{238}U). The maximum permissible concentrations recommended by ICRP and the other limit values proposed are based on the results of experiments that, though complete and valid in their general outline, are affected by the limited technical possibilities available when effected. Since now the possibilities of detecting and evidencing renal lesions are remarkably increased, it could be useful to review the problem of the chemical toxicity of uranium both on the basis of the advanced techniques available and on the experience gained in the field of health protection in nuclear environments. Modern techniques allow a relatively easy detection of even slight modifications and of their characteristics, at the same time they permit the carrying out of analysis of very small biological samples. (auth)

27214 (CONF-730907-P2, pp 1163-1168) DOSIMETRY OF INTERNAL EMITTERS IN NUCLEAR MEDICINE AND RADIATION PROTECTION. Nagaratnam, A.; Reddy, A. R. (Inst. of Nuclear Medicine and Allied Sciences, Delhi). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The inadequacy of conventional dosimetry at the organ level assuming a uniform activity distribution has been brought out in specific examples. In each case dosimetry at different anatomical levels is presented bringing out the probable understanding and lacuna in the radiobiological consequences of such dosimetry. Bone dosimetry of alpha and beta emitters is presented. Dose to whole kidney and differential doses to medulla and cortex from ^{203}Hg-neohydrin are described. The mean dose to lung from ^{131}I-MAA, the mean local dose to capillary bed and to capillary epithelium adjacent to an MAA particle are reviewed. The importance of Auger electron emission and the consequent transmutational effects is discussed with the examples of ^{125}I in thyroid, ^{125}I-UdR in proliferating cells, ^{55}Fe in erythrocytes. High doses to limited portions of fingers while handling ^{113m}In and ^{99m}Tc labelled pharmaceuticals are presented. (auth)

27215 (CONF-730907-P2, pp 1169-1174) CONTAMINATION OF AIR AND SURROUNDINGS BY PATIENTS TREATED WITH LARGE QUANTITIES OF IODINE-131 FOR THYROID CARCINOMA. Marshall, C. H.; Chandra, R.; Blum, M. (New York Univ., NY). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

On six occasions patients were treated with radioiodine for thyroid carcinoma and were isolated. The administered doses were in the range of 100 to 200 mCi of ^{131}I. All items from the room were collected, to determine the typical contamination deposited during the therapy. Continuous air monitoring was also performed. The total contamination collected on such items as bedding, towels and eating utensils was typically of the order of 1 mCi. Contamination of these items varied erratically during the first three days of therapy. Abnormally high levels of contamination were associated with certain medical disorders. Air burdens were in the range of 10 to 200 pCi per litre during the first day and usually declined progressively during the course of therapy. (auth)

27216 (CONF-730907-P2, pp 1175-1179) COMPREHENSIVE APPROACH FOR THE EVALUATION OF COMPARATIVE DOSIMETRY OF INTERNALLY ADMINISTERED RADIOPHARMACEUTICALS. Hosain, P.; Hosain, F. (Johns Hopkins Medical Institutions, Baltimore). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Recent innovations both in instrumentation and radiopharmaceuticals are helping nuclear medicine to develop as a discipline in medical practice primarily for diagnosis with an emphasis on scanning. Radiation safety of a radiopharmaceutical is based on the assessment of the radiation exposure to the critical organ from a tracer dose. It is also important to consider relative tracer doses necessary for an optimal result for selecting one of the several radiopharmaceuticals available for a similar investigation. A comprehensive formulation of an index has been attempted for the relative dosimetry integrating mainly (i) con-

ventional method of dose calculation, (ii) physical properties of radionuclide, (iii) available nuclear instrumentation, (iv) metabolic fate of radiopharmaceutical, and (v) gross considerations for radiosensitivity of organs and dose rate. This approach has been illustrated considering the situation of brain scanning using Hg-197 of chlormerodrin, Tc-99m pertechnetate, Tc-99m DTPA, short-lived In-113m DTPA and long-lived Yb-169 DTPA. (auth)

27217 (CONF-730907-P2, pp 1203-1207) RADIOACTIVE AEROSOLS AS A FACTOR IN INTERNAL IRRADIATION WHEN USING RADIOACTIVE SUBSTANCES. Bad'in, V. I.; Batova, E. G.; Parkhomenko, G. M. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In this report we consider the problem of determining the probable accumulation of the isotopes in the organism. These questions are solved on the basis of values of mean air contamination. The experimental results were applied to the regulation of the air contamination. Authors have proposed to use the term the standard work conditions in radiation protection practice. These conditions are characterized by the hygienical safety factor equal to 5, which should be included in the values of regulated MPC. (auth)

27218 INHALATION HAZARD TO WORKERS ENGAGED IN THE DEMOLITION OF BUILDINGS CONTAMINATED WITH RADIOACTIVITY. Duggan, M. J.; James, A. C.; Allen, S. G. (National Radiological Protection Board, Harwell, Eng.). Ann. Occup. Hyg.; 17: No. 1, 15-22 (Aug 1974).

Workers engaged in the demolition of buildings contaminated with radioactive materials may be at risk from the inhalation of radioactive dusts. The assessment of this risk during the demolition of two factories, formerly used (a) for the radium luminising of instrument dials, and (b) for processing monazite in the extraction of thorium and various rare earths, is described. Concrete floors contaminated in depth were broken up by pneumatic hammers and the measured specific activities of the resulting radioactive aerosols were related to the total contaminations. The results indicate that the radiation hazards associated with the demolition of contaminated buildings must be assessed before the work is undertaken, and dust suppression procedures employed where necessary. (UK)

27219 RADIATION HAZARDS IN APPLYING PROMETHIUM CONTAINING LUMINOUS PAINT TO CLOCK-FACES. Spittel, K. (Landesinstitut fuer Arbeitsschutz und Arbeitsmedizin, Karlsruhe (F.R. Germany). Abt. Immissions- und Strahlenschutz). Arbeitsschutz (Cologne); No. 1, 10-13 (Jan 1974). (In German).

6 figs.

Contrary to many other countries, promethium-activated luminous paints are still used in the German Federal Republic. With regard to better detection and control, the author proposes that tritium be used instead. Besides, promethium tests with animals and a routine analysis of urine samples from the personnel of luminous paint industry are demanded. (GE)

27220 THREE CASES OF THOROTRAST LATE DAMAGE. Truebestein, G. K.; Citoler, P. (Bonn Univ. (F.R. Germany). Medizinische Poliklinik; Bonn Univ. (F.R. Germany). Pathologisches Inst.). Med. Klin. (Munich); 68: No. 44, 1442-1447 (1973). (In German).

5 figs.; 1 tab.; 30 refs.

Three patients suffering from angioblastic sarcoma of the liver, from Thorotrast-induced malignant tumor, and from chronic myeloid leukemia 23 to 36 years after undergoing a Thorotrast angiography are considered. Based on the literature, the development of these late injuries especially leukemia, is discussed. (auth)

Animals

Refer also to abstracts 27074, 27153, 27155, and 27156.

27221 (CONF-730907-P1, pp 136-140) POTENTIATION OF STRONTIUM-90 BIOLOGICAL ACTION ON AN ORGANISM BY AGRICULTURAL CHEMICALS. Mukhin, I. E.; Borovikova, N. M.; Nagovitsina, L. I. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A mixture of ^{90}Sr and DDT was administered orally to rats daily for periods up to 330 days. Analysis of results showed that quantitative data are insufficient for evaluation of biological effects, especially in those cases where integral findings and possible effects are criteria. Accordingly, to elicit difference between the effects of the components of the binary mixture on the rate of weight increase, duration of life, and induction of tumors was attempted. The quantitative evaluation of the results with due regard for qualitative effects and time of their appearance led to the conclusion that the ^{90}Sr biological action was increased by the chemical (DDT) during their combined long-term administration to the organism. (auth)

27222 (CONF-730907-P1, pp 141-146) EFFECT OF INCORPORATED RADIONUCLIDES ON IMMUNITY. Nevstrueva, M. A.; Kolotvin, V. A.; Livshits, R. E.; Shubik, V. M. (Inst. of Radiation Hygiene, Leningrad). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Data are reported from a study on immunologic reactions including nonspecific and specific immunity, and allergic and autoallergic reactivity following a single and chronic administration of radioisotopes (Sr-90, I-131, Cs-137, Ce-144, Ra-226, Pu-239) to rats and rabbits. The differences of some radioisotopes and total irradiation effect on immunity are discussed. The dependence of immunological action upon biophysical properties of radioisotopes is postulated. (auth)

27223 (CONF-730907-P1, pp 159-166) CHANGE IN MEAN LIFETIME OF RATS IN DEPENDENCE ON FREQUENCY OF DEVELOPMENT OF OSTEOSARCOMAS INDUCED BY STRONTIUM-90. Shvedov, V. L. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Experiments were carried out on white rats at the age 3.5 to 4 months at the beginning of the experiment. The animals were divided into ten groups of 100 rats each. The animals of nine experimental groups received ^{90}Sr orally every day for the entire duration of their life, the dose being 0.00005; 0.0005; 0.005; 0.05; 0.5; 1.0; 2.0; 4.0 or 5.0 μCi daily per animal. The minimal ^{90}Sr daily intake which evoked the development of osteosarcoma was 0.5 μCi daily. The dose rate to the critical organ was not more than 25 rads daily, the absorbed dose being 5,000 rads. It was concluded that osteosarcomas were not the main cause of the average lifespan decrease of the population. (auth)

27224 (CONF-730907-P1, pp 167-171) REMOTE AFTER EFFECTS ASSOCIATED WITH DAMAGE BY TRANSURANIUM ELEMENTS. Moskalev, Yu. I.; Rudnitskaya, E. I.; Buldakov, L. A.; Nifatov, A. P.; Filippova, L. G. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The development of malignant and neomalignant neoplasms after the intake of various compounds of ^{239}Pu, ^{241}Am, and ^{237}Np was studied in dogs and rats. Dogs and rats after the intake of transuranium elements developed osteosarcomas, leukoses, tumors of lungs, liver, kidneys and other organs, sclerotic processes (contracted liver, nephrosclerosis, pneumosclerosis) at the sites of deposition or transition of the isotope and septical processes of various localization. After the intake of ^{239}Pu the minimum carcinogenic dose was within 5 rad and after ^{241}Am it was 17 rad. The maximum frequency of osteosarcoma development after the intake of ^{241}Am was 33% in rats and 100% in dogs. With the decrease of dose accumulated in the bone tissue the relative osteosarcomagenic efficiency was increased in dogs as compared to rats from 3 to 30 times. When the doses were close to minimum effective ones the osteosarcomagenic activity of ^{239}Pu was five-fold that of ^{241}Am. The development of leukosis after the intake of transuranium elements was more frequent and occurred at earlier periods relative to control animals. The maximum yield of kidney tumors (2 to 4.5%) was observed with ^{241}Am when the doses used were within 35 to 200 rad. After the inhalation of soluble compounds of ^{241}Am the frequency of pneumosclerosis and lung tumor development was lower as compared to ^{239}Pu. The routes of ^{241}Am and ^{239}Pu intake into the body did not affect the values of carcinogenic doses for the particular tissue. The minimum osteosarcomagenic leukemo-

genic dose for nitrate of ^{237}Np after intravenous injection was below 0.1 Ci/kg. (auth)

27225 (CONF-730907-P1, pp 196-200) STRUCTURAL ABERRATIONS IN BONE MARROW CELLS AFTER TRITIATED WATER ADMINISTRATION IN RATS. Andreuta, I.; Racoveanu, N. T. (Inst. of Hygiene and Public Health, Bucharest). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Aberrations of chromosomes in bone marrow cells were used as a biological test of HTO irradiation. Three groups of nine rats were used: two groups received a single intraperitoneal dose of 75 and 100 μCi/g HTO; one group received daily 30 μCi/g HTO for 18 days and 5 animals receiving saline solution served as controls. The structural aberrations were of chromatid (gaps and breaks) and chromosomal type (acentric fragments and translocations). A relationship between calculated bone marrow dose and chromosome aberration incidence was established. (auth)

27226 (CONF-730907-P1, pp 201-207) MODIFICATION OF SOME BIOLOGICAL INDICATORS INDUCED BY SINGLE AND REPEATED ADMINISTRATION OF TRITIATED WATER. Stanculescu, V.; Ciubotaru-Bordeianu, A. (Inst. of Hygiene and Public Health, Bucharest). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Experiments were performed on white rats exposed to the action of tritium from tritiated water (HTO) by single (ip) and repeated (oral) administration. The results showed that in the lots that received HTO, as compared to the controls, there was a lower percentage of iron incorporation in the red blood cells, and an early accumulation of ^{59}Fe was noticed in bone marrow; however longer biological half time (Tb) indicate a prolonged retention of iron, which was also found in the spleen. The relative spleen weight was noticeably reduced in the animals that received larger quantities of HTO. The unsaturated iron binding capacity (UIBC) evinced a decreasing tendency, which shows that, after exposure to HTO, the degree of iron saturation of transferrin is higher. Comparison with the extent to which the same indicators are modified after whole-body x-ray exposure suggested that exposure to HTO causes a lesser effect than expected for the calculated dose. (auth)

27227 (CONF-730907-P1, pp 208-213) COMPARATIVE TOXICITY OF INHALED BETA-EMITTING RADIONUCLIDES IN BEAGLE DOGS. McClellan, R. O.; Boecker, B. B.; Hahn, F. F.; Hobbs, C. H.; Jones, R. K.; Snipes, M. B. (Lovelace Foundation for Medical Eduaction and Research, Albuquerque, NM). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Four lifespan studies are being conducted in which beagle dogs are exposed via inhalation to aerosols of fused clay particles containing ^{90}Y, ^{91}Y, ^{144}Ce, or ^{90}Sr resulting in graded initial lung burdens of radioactivity. With all four aerosols, the labeled particles are tenaciously retained in the lung with effective retention half-times of 2.6, 53, 178, and 400 days, respectively. With the ^{91}Y, ^{144}Ce, and ^{90}Sr in fused clay, the physical half-life is sufficiently long to allow translocation of small quantities of radioactivity, presumably in particulate form, to tracheobronchial lymph nodes and movement of solubilized ^{91}Y and ^{144}Ce to liver and skeleton and ^{90}Sr to skeleton. With the highest initial lung burdens, deaths related to radiation pneumonitis and pulmonary fibrosis were observed in all four studies within 400 days post-inhalation exposure. The radiation dose required to produce early deaths was lowest for ^{90}Y and highest for ^{144}Ce and ^{90}Sr being related to the lung retention half-times (and rate of decrease of radiation dose rate). Later deaths (>640 days) related to primary pulmonary hemangiosarcomas were observed in dogs that inhaled ^{144}Ce or ^{90}Sr in fused clay with cumulative lung doses >20,000 rads. (auth)

27228 (CONF-730907-P2, pp 1156-1162) RADIOBIOLOGICAL SIGNIFICANCE OF ^{125}I MICRODOSIMETRY. Reddy, A. R.; Nagpal, K. K. (Inst. of Nuclear Medicine and Allied Sciences, Delhi). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Significant difference in the microscopic dose distribution due to ^{125}I and ^{131}I in the thyroid gland is reported. Its radiobiological significance is studied using varying doses of these two radionuclides in one-month-old rats. The total body weight increase, thyroidal retentivity of radioiodine, 24 hour uptake and the thyroid weight at the end of the treatment are measured in both the treated and control groups. Thyroid weight is taken as an index of thyroid cell population and any reduction in its increase with age compared to that in controls (which is taken as 100% cell survival) is considered as due to the impairment of proliferative capacity of the thyroid cells. Average gland doses due to ^{125}I and ^{131}I for 50% cell survival are 40500 and 18500 rad respectively. The 24 hour uptake is significantly reduced in 71 μCi ^{131}I treated rats whereas in all other treated ones there is no change compared to controls. Body weight increase is impaired in both the treatments, more so with ^{125}I. These differences are explained in terms of differences in dose distributions across a thyroid follicle due to ^{125}I and ^{131}I. (auth)

27229 EFFECTS OF ^{90}Sr AND ^{137}Cs ADMINISTERED CONTINUOUSLY UPON MICE. VIII. Abnormality of Reproductive Function. Nishio, K. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 12: 111-112 (Mar 1972).

Reproduction of mice administered continuously with ^{90}Sr and ^{137}Cs through drinking water was observed regarding litter size and reproduction-span in particular (period between 1st and last birth). Propagation of NA-2 strain of mice was done by brother-and-sister mating in the same cage during the whole life. The concentration of the isotopes in water was composed of three levels. The high level was 0.1 μCi of ^{90}Sr and 0.4 μCi of ^{137}Cs per ml, the intermediate level was 1/10, and the low level was 1/100 respectively. In the low group, total litter size decreased slightly and the reproduction span was lengthened. Intermediate- and high-groups showed decrease of total litter size and shortening of reproduction span except for a partial increase of litter size in first birth in intermediate group. (auth)

27230 COMPARISON OF THE EFFECTS OF CHEMICAL, SURGICAL, AND RADIOTHYROIDECTOMY IN SPOTTED MUNIA, LONCHURA PUNCTULATA. Chandola, A.; Thapliyal, J. P. (Banaras Hindu Univ., India). Gen. Comp. Endocrinol.; 22: 138-131 (Jan 1974).

Surgical and radiothyroidectomy suppressed feather regeneration and increased the weight of the body, liver, gonads, and gonoducts in Spotted Munia. Chemical thyroidectomy (methylthiouracil) differed only in not being able to affect gonad and gonoduct weight, probably because of incomplete impairment of thyroid function. (auth)

Microorganisms

27231 COMPARATIVE INVESTIGATION OF THE MUTAGENIC EFFECT OF INCORPORATED ISOTOPES OF THE MOST IMPORTANT ORGANOGENIC ELEMENTS. IV. Comparison of Lethal and Mutagenic Effects of the Decay of ^{32}P and ^{35}S Incorporated in Cells of Escherichia Coli Try^-Leu^-. Pluchennik, G. (Univ., Warsaw). Genetika; 10: No. 7, 103-113 (Jul 1974). (In Russian).

Quantitative data were obtained on the lethal and mutagenic (reversions $Try^- \rightarrow Try^+$ and $Leu^- \rightarrow Leu^+$) effects induced by the decay of ^{32}P and ^{35}S incorporated into the cells of Escherichia coli $Try^- Leu^-$. The mutagenic effect of the conversion $^{35}S \rightarrow {}^{35}Cl$ was shown to exceed by five times that of the conversion $^{32}P \rightarrow {}^{32}S$. A conclusion is drawn that the accuracy of selection of nucleic bases in cases of restrictive replication is inferior to that in cases of vegetative replication. (auth)

27232 COMPARATIVE INVESTIGATION OF MUTAGENIC EFFECT OF INCORPORATED ISOTOPES OF THE MOST IMPORTANT ORGANOGENIC ELEMENTS. V. Comparison of Lethal and Mutagenic Effects Induced by the Decay of ^{32}P and ^{35}S Incorporated in Cells of Escherichia Coli B Try^-. Pluchennik, G. (Inst. of Fundamental Chemical Problems, Warsaw). Genetika; 10: No. 7, 114-121 (Jul 1974). (In Russian).

Quantitative data are obtained on the induction of the lethal effect and of the $Try^- \rightarrow Try^+$ reversions in Escherichia coli B Try^- by the decay of incorporated ^{32}P and ^{35}S. It is shown by the comparison of the mutagenic effects of the decay of ^{32}P and ^{35}S in case of the same lethal effect, that the mutagenic effect of the $^{35}S \rightarrow {}^{35}Cl$ conversion is over thrice that of the conversion $^{32}P \rightarrow {}^{32}S$. The mechanism of the mutagenic effect of the $^{35}S \rightarrow {}^{35}Cl$ conversion is discussed. (auth)

27233 GENETIC EFFECTS OF ^{35}S DECAY IN CELLS OF YEAST SACCHAROMYCES CEREVISIAE. II. Mutagenic Effect and the Nature of the Induced Mutations. Korolev, V. G.; Gra-

cheva, L. M.; Bolotnikova, E. V. (Inst. of Nuclear Physics, Moscow). Genetika; 10: No. 7, 91-96(Jul 1974). (In Russian).

The induction of mutations in haploid cells of yeast Saccharomyces cerevisiae by the decay of incorporated radiosulphur was studied. The mutagenic effect of ^{35}S was compared with that of incorporated ^{32}P and external β-radiation. The results of experiments showed that the efficiency of incorporated ^{35}S was practically equal to the efficiency of ^{32}P and it was 15 times higher than that of external β-radiation. Complementation tests were made on 139 ade-mutants induced by the decay of ^{35}S. The ratio for ade_1 and ade_2 mutations was 1 to 2.5. Studies of the nature of mutations showed that most of ^{35}S-mutants (93%) carried mutations of the type of base exchanges. (auth)

Nuclide Kinetics and Toxicology

Refer also to abstracts 26757, 27207, and 27218.

Man

Refer also to abstracts 26398, 26449, 26804, 26805, 26807, 26845, 26847, 26848, 27056, 27080, 27094, 27213, 27293, 27298, 27301, 27303, 27305, 27306, and 28825.

27234 (CONF-730907-P1, pp 538-543) EXCRETION OF TRITIUM IN WORKERS PREPARING LABELLED COMPOUNDS. Houskova, M.; Cajkova, A.; Kunz, E.; Namestek, L. (Inst. of Hygiene and Epidemiology, Prague). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Analysis of results of tritium excretion in workers preparing labeled compounds proved the applicability of the method of measuring tritium in exhaled breath for the evaluation of HTO excretion, and showed the need to determine organically bound tritium or the total activity of tritium in urine. The mean ratio of exhaled breath to distilled urine activities amounted to 0.88 ± 0.18. The biological half-life T_b of HTO excretion was 11.4 ± 2.1 days on the average. In a worker followed for 600 days following exposure another half-life component was determined of 240.2 ± 8.4 days. Organically bound tritium was excreted with a half-life lower than 2.5 days. (auth)

27235 (CONF-730907-P1, pp 637-642) DOSIMETRIC STUDY OF RESIDUAL BRAIN CONTAMINATION AFTER THE INJECTION OF A SOLUTION OF YTTERBIUM-169-DTPA IN THE CEREBROSPINAL FLUID. Zerbib, J. C. (CEN, Saclay, France); Imbert, L.; Bonleu, M.; Joffre, H.; De Tovar, G.; Beaufils, F.; Collonge, M. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Using radionuclides for medical diagnostic purposes raises the question of the radiation dose emitted by the radioactive products which are taken up in the system, whether preferentially or not. Results are reported from a study of the retention of ytterbium-169-DTPA after sub-occipital injection of the product into cerebrospinal fluid of a patient. A spectrometric analysis enabled the activity of the ytterbium-169 taken up in the patient's brain mass to be known. A simulation carried out on a phantom was made using as guide the space distribution of the radionuclide observed by scintiscanning and the quantitative results of gamma spectrometry. The measurements made on the patient as well as on the phantom enabled the observed dose due to the photons to be determined. Along a horizontal plane passing through the eyes of the patient, the average absorbed dose was of several tens of rads in the central area of the brain. In two other patients, the scintiscanning results showed a 20 to 30% retention of the injected ytterbium-169 after a rapid initial elimination phase. Autoradiograms were made of a frontal section of the brain of a patient on whom an isotopic study was made five weeks before death. This autoradiography showed that the radioactive product had spread throughout the brain and was taken up preferentially near the ventricular walls. (auth)

27236 (CONF-730907-P1, pp 731-735) RETENTION AND ELIMINATION OF BERKELIUM-249-CALIFORNIUM-249 FOLLOWING ACUTE ACCIDENTAL INHALATION. Rundo, J.; Sedlet, J. (Argonne National Lab., IL). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A case of accidental inhalation of a small quantity of an ignited mixture of ^{249}Bk and its decay product, ^{249}Cf, was studied by whole-body radioactivity measurements and excretion analyses during the first year after intake. The initial chest content of about 3 nCi of ^{249}Cf declined according to a 2-component exponential function of time (half-lives of 25 days and 1210 days). Except for an initial rapid clearance via the feces, the urinary and fecal excretion rates of both nuclides increased with time until 60 to 70 days after intake and then declined. If the early fecal excretion was neglected, the results could be described as the difference between two exponential components with half-times of 15 to 30 days and 90 to 130 days. (auth)

27237 (CONF-730907-P2, pp 926-931) EVALUATION OF THE RADIATION FACTOR AT ENTERPRISES IN THE RARE AND FERROUS METALS INDUSTRY. Lyarskii, P. P.; Elovskaya, L. T.; Kapitanov, Yu. T.; Likhachev, Yu. P.; Satarina, S. Ya.; Khukhlaeva, S. A. Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

When working with natural radioactive raw materials of different mineral composition and different specific activity due to the type and conditions of the particular jobs, the environment in which man works can reveal different extents of activity of individual components of the factor of radiation. Surface jobs with mineral raw materials and their processed products are extremely typical for their dusts containing long-term α-irradiators. Such dusts pollute the air environment of some production premises of ore-dressing and chemical and metallurgical enterprises. Under examination was the state of health in workers with long terms of service. No harmful effects on the respirative organs that could be directly related to the radiation factor have been discovered so far. However the longest term up to 20 years was only in a small group of the examined. The amount of Th incorporated into the workers' lungs evaluated by the preliminary data taken from the entire body and the Th content in the respirated air did not exceed 150 pCi. The authors studied 3500 white ordinary rats intratracheally injected with dusts of various specific activity as well as chronically inhalated for long terms. With a combined dust-radiation action the lowest effective dose to affect the lungs is close to 200 rem. In view of the increased fibrogenic properties of dusts containing radioactive elements the authors stress the necessity to consider the long-term natural radioactive component of mineral dusts when fixing the permissible limits of general pollution within the operation zone of the production premises. The authors regard as open the question on possible distant effects in workers with 30 to 50 years of service since with the length of service increased it is quite possible for the lungs to absorb doses equal to the maximum permissible ones. (auth)

27238 (CONF-730907-P2, pp 963-968) OPTIMIZATION OF CONDITIONS FOR GAMMA-SPECTROMETRIC MEASUREMENTS IN RADIATION SHIELDING. Lebedev, O. V.; Malykhin, V. M. (Inst. of Radiation Hygiene, Leningrad). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Some problems of sample and human body radioactivity measurement optimization are discussed on the basis of new radiometric quality criteria and analysis of about 100 whole-body counters' data. (auth)

27239 (CONF-730907-P2, pp 976-978) SENSITIVE RADIOMETRIC METHOD FOR IN VIVO STUDY OF INCORPORATED NUCLIDES OF THE THORIUM SERIES. Petushkov, A. A.; Zel'tser, M. R.; Lyarskii, P. P. Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The complex of the apparatus and methods for the assessment of Th-228 body burden in man was developed. The correlation is found between content of thoron in the breath, which was measured by a special scintillation apparatus (0.05 pCu/l sensitivity), and Ra-224 in the excretion, which was measured by the method of the high emanating samples preparation (0.05 pCu sensitivity) with the activity of Th-228 body burden in man. (auth)

27240 (CONF-730907-P2, pp 985-990) IN VIVO MEASUREMENTS FOLLOWING EXPOSURE TO ^{133}Xe AND ASSOCIATED DOSE ASSESSMENT PROCEDURES. Fry, F. (Atomic Energy Research Establishment, Harwell, Eng.); Tyler, G. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Information is presented on the retention and distribution of ^{133}Xe in the human body as determined by in-vivo counting. Calculations by other workers have shown that for exposure to ^{133}Xe gas the critical dose is that to the skin. It is shown here, with reference to three cases, how measurements of the body content of ^{133}Xe made by in-vivo counting can be used to estimate skin doses. By reference to actual recent cases attention is drawn to problems caused by ^{133}Xe intakes in the interpretation of external contamination and plutonium-in-lung measurements. (auth)

27241 (CONF-730907-P2) PROCEEDINGS OF THE THIRD INTERNATIONAL CONGRESS OF THE INTERNATIONAL RADIATION PROTECTION ASSOCIATION. Snyder, W. S. (ed.). (International Radiation Protection Association, Washington, D. C. (USA)). Feb 1974. 1011-1016.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

The commonly used method for detection of internal contamination of uranium, as well as of all other radionuclides, is urinalysis. In cases of nontransportable natural uranium contamination by inhalation, experience has shown that urinalysis gives erratic results, which do not enable accurate calculation of the inhaled amount. A method for direct in vivo measurement of natural uranium, utilizing the 186 keV line of uranium-235, was developed utilizing a whole-body counter by placing the detector directly over the lung area. This procedure requires however corrections due to the presence of cesium-137 and potassium-40 in the body and the parallel measurement of a "double" as a control. A newly developed method gives direct in vivo determination of uranium contamination by counting the soft L x rays (10 to 20 keV) contribution of uranium-238 and uranium-234. Counting is done inside the low background whole-body chamber with two proportional detectors (30 × 15 cm) flushed with argon and methane. Quantitative calibration was done with sponges saturated with UO_3 and placed in a chest cavity of a male goat weighing 75 kg. Counts due to uranium are much higher than those contributed by the normally existing amounts of cesium-137 and potassium-40 thus enabling a detection threshold of at least $\frac{1}{3}$ of the maximum permissible lung burden. Work is in progress for improvement of apparatus and methodology. (auth)

27242 (CONF-730907-P2, pp 1047-1053) ENVIRONMENTAL TRITIUM AND THE DOSE TO MAN. Bennett, B. G. (Atomic Energy Commission, New York). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The dose to man from acute or chronic intake of tritiated water was determined using a three-compartment model to describe the retention of tritium in loose water and in bound organic form in the body. The retention times determined from occupational exposure cases are reviewed. The total tissue dose, using representative retention half-times for the three components of 9, 30, and 450 days, is 84 mrad per 1 mCi intake by standard man, 84% of which is due to tritium in body water and 16% to bound tritium in tissue. The record of environmental tritium concentrations in surface waters has been compiled. Maximum levels caused by weapons testing occurred in 1963-64. Subsequent decrease is exponential with a half-time of 3.2 years. By relating environmental tritium levels to daily intake by man and applying the dose model, the dose commitment of 1.5 mrad from fallout tritium was determined. (auth)

27243 (CONF-730907-P2, pp 1220-1225) EFFECT OF BREATH-HOLDING ON THE DEPOSITION OF HALF-MICRON AEROSOL PARTICLES IN THE HUMAN LUNG. Subba Ramu, M. C. (Bhabha Atomic Research Centre, Bombay). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Measurements of deposition of particles in the human lung during breath-holding can be made use of to calculate the diameter of the tubular passageways of the respiratory tract in life. When the inspired volume is sufficiently great for most of the aerosol to penetrate beyond the anatomical dead space, the rate of deposition during the breath-holding can be regarded as an index of the average diameter of the alveolar airways. Studies of the effect of breath-holding on deposition and recoveries of 0.5 μm particles of unit density in different lung volumes are described in this paper. Based on the results of steady-state breathing experiments, the average diameter of the airways in the alveolar region of the lung has been found to be 0.74 mms. (auth)

27244 (CONF-730907-P2, pp 1226-1231) HASL CYCLONE AS AN INSTRUMENT FOR MEASURING AEROSOL PARAMETERS FOR NEW LUNG MODEL. Kotrappa, P.; Dua, S. K.; Bhanti, D. P.; Joshi, P. P. (Bhabha Atomic Research Centre, Bombay). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Recently proposed ICRP Lung Model stipulates that a knowledge of an aerosol parameter, activity median aerodynamic diameter (AMAD) is essential to predict the fractional depositions in various parts of the respiratory tract. It is shown that this method of determining AMAD does not reflect significant error in the estimation of pulmonary deposition over a size range of 1.5 to 8.0 μm. Results of a large number of measurements made in Trombay Fuel Reprocessing Plant are reported. Results compare well with similar measurements made by other techniques such as Centripeter and Autoradiography. Significance of the measured AMAD is discussed with respect to maximum permissible concentrations (MPC) in air. (auth)

27245 (CONF-730907-P2, pp 1232-1236) DOSE COMMITMENT TO THE LUNG FROM INHALATION OF RADIOCOBALT IN POWER REACTOR OPERATIONS. Kotrappa, P.; Soman, S. D.; Raghunath, B. (Bhabha Atomic Research Centre, Bombay). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Personnel working in the operational and maintenance areas of Tarapur Atomic Power Plant (BWR Type) have shown detectable amounts of ^{60}Co in their system, notably in the lung area. Large number of gross and respirable air samples taken in the working areas provided the air activity levels of ^{60}Co and also the aerosol parameter, activity median aerodynamic diameter (AMAD). These data in conjunction with the long term clearance half-life available in literature are used to compute the quantity of ^{60}Co in lungs at any time due to chronic inhalation. Parameters of the new ICRP lung model are used in the computation. Radiation dose commitment to the lung due to the retained ^{60}Co is computed. (auth)

27246 (CONF-730907-P2, pp 1237-1242) METHOD FOR DETERMINING THE DISSOLUTION CHARACTERISTICS OF ACCIDENTALLY RELEASED RADIOACTIVE AEROSOLS. Kanapilly, G. M.; Raabe, O. G.; Boyd, H. A. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Early assessment of the dissolution characteristics of radioactive aerosol particles involved in inhalation accidents is important for hazard evaluation and selection of proper therapeutic procedures. Since accidentally produced aerosols are usually of undetermined physicochemical properties, prediction of their dissolution characteristics is difficult. Therefore, a rapid experimental evaluation of their dissolution behavior is desirable. An in vitro method is described which provides both early and long-term measurements of dissolution behavior of aerosol samples in a parallel-flow system which simulates in vivo dissolution as in the lung after inhalation deposition. Health physics applications of dissolution data are discussed. (auth)

27247 (CONF-730907-P2, pp 1255-1260) INHALATION HAZARDS: THEY COULD BE WORSE. Thomas, R. G. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The inhalation route of entrance of relatively insoluble radioactive toxicant particles to the body may afford several mechanisms that act to reduce the potential radiation hazard, as compared to entrance by other possible routes. A relatively minor fraction of what is inhaled actually reaches the pulmonary spaces of the lung. In addition, those particles that do reach this region of the respiratory tract have the opportunity of being cleared by at least three methods; muco-ciliary movement, dissolution and subsequent removal by the blood, and translocation to tracheobronchial lymph nodes. With relatively insoluble particles all of these factors appear to work toward helping the individual to reduce the radiation insult. The methods proposed to bring about this reduction through these various factors are discussed in general terms. (auth)

27248 (CONF-730907-P2, pp 1347-1352) STUDY OF INHALED SODIUM-22. Bush, D. (Univ. of Birmingham, Eng.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

This is a study of small intakes by inhalation of ^{22}Na which occurred during the machining of an irradiated target. The arrangements for handling and machining the targets are described. Measured levels of surface contamination and airborne activity, together with particle size data, are given. Whole-body counting results, and measurements of the distribution of activity in the body and its variation with time are presented. The information obtained is considered in relation to predictions based on the models of the I.C.R.P. Task Group on Lung Dynamics, and the data given in I.C.R.P. Publication 10. (auth)

27249 (CONF-730907-P2, pp 1353-1357) METABOLISM OF LEAD-210 AND POLONIUM-210 IN THE BODY. Nizhinkov, A. I.; Dolgirev, E. I.; Ibatullin, M. S.; Ramzaev, P. V.; Troitskaya, M. N. (Inst. of Radiation Hygiene, Leningrad). Feb 1974. (In Russian).

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Metabolism parameters of Pb-210 and its product (in the body) Po-210, necessary for dosimetry and standardization are obtained in man during short-termed observations. Investigations were carried out on a volunteer group. These investigations deal with the specification of absorption and clearance rate of these isotopes administered per os as indicators and sufficient for many years' observations using in vivo measurements and excretion analyses. Genetically related mixture of Pb-210 and Po-210 was administered orally to the four people (the authors) whose excretions had been previously analyzed for Po-210 for a year after a single incorporation. This experiment will contribute to the understanding of Po-210 metabolism. The first results of the investigations are presented and these experiments will be continued. (auth)

27250 (CONF-730907-P2, pp 1358-1363) USE OF A SPECIALIZED ANALOG COMPUTER FOR THE MODEL OF THE METABOLISM OF SOME RADIONUCLIDES. Likhtarev, I. A.; Arkhangelskaya, G. V.; Dobroskok, A. I.; Zvonova, I. A.; Korelina, N. F.; Krasnoshekova, G. P.; Repin, V. S.; Ushakova, A. P. (Inst. of Radiation Hygiene, Leningrad). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Three types of non-linear problems of the compartment analysis are considered. The problems are studied and solved by means of an analog computer. To this end, a suitable structural scheme was developed for each problem. The obtained predictions are in good agreement with some experimental findings, which give every reason to consider the suggested models to be adequate. Thus, the analog computer modelling provides an effective means for the quantitative analysis of the sufficiently complicated non-linear problems of radionuclide transport in the living organism. (auth)

27251 (CONF-730907-P2, pp 1364-1370) INTERPRETATION OF EXPERIMENTAL DATA ON POLONIUM-210 METABOLISM FOR COMPUTING ADMISSIBLE LEVELS. Parfenov, Yu. D. (Inst. of Biophysics, Moscow). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Experimental data on ^{210}Po metabolism in animals show that there are some uncertainties for the value of absorption into the blood from the gastro-intestinal tract and from the respiratory system; for the choice of the critical organ and for assessment of the nonuniformity of the internal irradiation. However there is no real basis for radical changes in the existing admissible levels of ^{210}Po intake into the human body. (auth)

27252 (CONF-730907-P2, pp 1377-1383) DETERMINATION OF THE CONTENT AND KINETICS OF THE BEHAVIOR OF SOME RADIONUCLIDES IN THE BODY OF MAN BY THE IN VIVO TECHNIQUE. Turkin, A. D.; Stolyarov, V. P.; Sokolov, Yu. Ya. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The regularities in accumulation, distribution, and elimination of krypton-85, xenon-133, and iodine-131 from the body of man have been studied on volunteers. It is shown that intake of the inert radioactive gasses and gaseous iodine into the human body is primarily through the respiratory organs. The intact skin is of little importance in this process. (auth)

27253 (CONF-730907-P2, pp 1384-1389) RETENTION AND DISTRIBUTION OF INORGANIC MERCURY (^{197}Hg,^{203}Hg) IN THE HUMAN BODY AFTER SINGLE INHALATION. Izumi, Y.; Fujita, M.; Yabe, A.; Hattori, T. (Japan Atomic Energy Research Inst., Tokai). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Inorganic mercury (^{197}Hg,^{203}Hg) was inhaled by two workers during decontamination procedures in a hot cell. The retention and distribution of the mercury in the body were studied with a whole-body counter. The biological half-lives in the whole body were about 33 days, which was shorter than those reported for organic mercuries. The biological half-lives in the upper abdomen were about 50 days. Scanning along the body axis and counting at several different points above the upper abdomen revealed that the mercury deposited mainly in the kidneys and in the liver. The activities of the mercury-203 in the kidneys and in the liver were determined using the counting efficiencies obtained from a REMAB phantom. The total activities in the kidneys 10 days after inhalation were almost equal to those in the liver. The high concentration in the kidneys, about 5 times as high as that in the liver, suggested that the kidneys were the critical organ for the inhalation of inorganic mercury. (auth)

27254 (CONF-730907-P2, pp 1390-1395) CASE STUDY OF HUMAN CONTAMINATION DUE TO INHALED THULIUM-170 OXIDE. Yabe, A.; Yamagishi, H.; Fukuda, H.; Takahashi, Y.; Mizushita, S.; Hattori, T. (Japan Atomic Energy Research Inst., Tokai). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

One worker incidentally inhaled submicron particles of thulium-170 oxide. Data obtained by in-vivo counting and bioassay over about 450 days after inhalation fitted to a sum of three exponential terms having effective half-lives of about 3, 23, and 90 days, respectively, though the half-life of 3 days was not distinctly determined. Attempts were made to express the daily fecal and urinary excretion by power function and to relate the excretion with the decrease of the chest burden. In addition, the distribution and transfer of thulium in the body were discussed. (auth)

27255 (IAEA-R-937-F) STUDIES OF THE RETENTION AND THE ELIMINATION OF RADIOACTIVE IODINE FROM THE HUMAN BODY. Final Report, 1 August 1970–31 July 1973. Malamos, B. (International Atomic Energy Agency, Vienna (Austria)). Aug 1973. 5p. INIS.

To a group of euthyroid persons undergoing radioiodine function tests, the following drugs were given one week after an oral ad-

ministration of a 45 μCi dose of ^{131}I: potassium iodide, 60 mg/daily, 6 cases; carbimazole, 40 mg/daily, 8 cases; potassium iodide, 30 mg/daily with carbimazole 40 mg/daily, 6 cases; TSH, 10 i.u. i.m. the 7th, 8th, 9th, 11th and 13th day, 6 cases; and TSH, 10 i.u. the 7th, 8th, 9th, 11th and 13th day combined with carbimazole 40 mg/daily, 6 cases. The results were compared with those obtained in a group of 8 controls not receiving any treatment. Composite radioiodine uptake curves for the various groups were made from the data obtained. It was concluded that the most effective treatment is the combination of TSH and carbimazole. A marked elimination of ^{131}I from the thyroid takes place accompanied by a great increase of the urinary elimination of the radioisotope. If early after an accidental incorporation of radioiodine has taken place, the patient is given potassium iodide starting with a minimal initial dose of 40 mg and continuing with at least 3.3 mg of potassium iodide daily, significant prevention of uptake by the thyroid gland is possible. If however, therapy is delayed, there is still room for treatment. The results of the research suggest that treatment is most successful if TSH injections are combined with an oral administration of carbimazole in doses sufficient to block the formation of organically bound iodine. (INIS)

27256 RADIOZINC UPTAKE AND SCINTISCANNING IN PROSTATIC DISEASE. Chisholm, G. D.; Short, M. D.; Ghanadian, R.; McRae, C. U.; Glass, H. I. (Hammersmith Hospital, London). J. Nucl. Med.; 15: No. 9, 739-742(Sep 1974).

Zinc radioisotopes have been used to study the tissue distribution of zinc in the rat and human and to obtain scintigraphic images of the prostate in man. Two hours after administration of ^{65}Zn into the rat most of the radioactivity was found to be in kidney, liver, pancreas, and prostate. However, after 20 hr the uptake of ^{65}Zn by kidney, liver, and pancreas decreased whereas the uptake of radioactivity in the prostate, seminal vesicle, and bone continued to increase. The uptake of ^{65}Zn by prostate, bladder, and muscle was measured in patients with benign prostatic hypertrophy (BPH) by injecting ^{65}Zn at different periods prior to open prostatectomy. There was a continuous increase in the concentration of ^{65}Zn by the prostate whereas the concentration in muscle remained constant. The greatest contrast between prostate and surrounding muscle was found to be between 12 to 24 hr after administration. Using ^{62}Zn, prostate images were obtained in patients with BPH and carcinoma of the prostate. The scintiscan showed only an indefinite outline of the prostate in BPH. The results demonstrate the limitations of these radioisotopes in the study of prostatic disease. (auth)

27257 CONTAMINATION OF HUMAN MILK BY CESIUM-137 AND STRONTIUM-90 IN BELGIUM FROM 1966 TILL 1968. Versele-Declercq, H.; Gillard-Baruh, J. J. Belge Radiol.; 57: No. 2, 129-135(1974). (In French).

Up to now, little attention has been paid to human milk as a source of contamination for newborns and young children. The following study concerns cesium-137 and strontium-90 measurements in human milk from January 1966 up to June 1968. The information thus obtained shows a decrease of human milk contamination in a ratio of 4 to 1 for cesium-137 and of 2 to 1 for strontium-90 during the period studied, similar ratios apply in the case of cow's milk. Furthermore, human milk is far less contaminated both in cesium-137 and strontium-90 than cow's milk. Those results constitute an additional argument in favor of breast feeding. (auth)

27258 KIDNEY AND BONE RETENTION FUNCTIONS IN THE HUMAN METABOLISM OF URANIUM. Adams, N.; Spoor, N. L. (National Radiological Protection Board, Harwell, Eng.). Phys. Med. Biol.; 19: No. 4, 460-471(Jul 1974).

The retention of uranium by bone and kidney was re-evaluated taking account of recently published data for a man occupationally exposed to natural uranium aerosols and for adults who had ingested uranium at the normal dietary levels. For lifetime occupational exposure to uranium aerosols the new retention functions yielded a greater retention in bone and a smaller retention in kidney than the earlier ones, which were based on acute intakes of uranium by terminal patients. Hence bone replaces kidney as the critical organ. The occupational $(MPC)_a$ for ^{238}U and the $(MPC)_a$ for U-nat based on radiological considerations using the ICRP (1959) lung model and the new retention functions are slightly lower than for the earlier ones. For ^{238}U the $(MPC)_a$ determined by chemical toxicity remains the more restrictive. (auth)

27259 STRONTIUM-90 IN HUMAN BONES IN BELGIUM FROM 1967 TILL 1969. Gillard-Baruh, J. H. C. (Institut d'Hygiene et d'Epidemiologie, Brussels). J. Belge Radiol.; 57: No. 2, 137-143(1974). (In French).

In order to obtain a more precise determination of the anatomical and physiological factors that are to be considered in radioprotection calculations, it is advisable to look for more direct methods of measuring the internal contamination of man. The following study concerns measurements of the strontium-90 content of children vertebrae, from 1967 until 1969. The age of the children at the time of death varied between 0 and 5 years. The information thus obtained can then be compared to the contamination of the diet during the same period. An attempt to explain the results according to age does not show any significant differences between the age groups during the period of study. (auth)

27260 THEORETIC AND EXPERIMENTAL MODELS FOR DUST DEPOSITION AND RETENTION IN MAN. Morrow, P. E. (Univ. of Rochester, NY). Rev. Environ. Health; 1: No. 3, 185-212(1974).

Respiratory system models, both theoretical and experimental, are briefly reviewed and their application to problems of dust deposition and retention in man is discussed. Models for nasal, tracheobroncial, and parenchymal deposition and retention are mentioned. (70 references) (ERB)

27261 SENSE AND NONSENSE OVER PLUTONIUM TOXICITY. Nooteboom-Beekman, Z. M.; Verkerk, B. (Stichting Reactor Centrum Nederland, The Hague). Atoomenergie Haar Toepass.; 16: No. 6, 139-141(Jun 1974). (In Dutch).

Recent reports on the toxicity (and carcinogenicity) of plutonium are summarized and assessed. While some of the more "alarmist" pronouncements are discounted as unfounded, it is emphasized that more data are needed before complete confidence can be placed in existing safeguards. This data must be acquired and evaluated as a matter of urgency, in view of the expected increase in plutonium production and usage in fast breeder programmes over the next decades. (NL)

Animals

Refer also to abstract 27294.

27262 (CONF-730907-P1, pp 117-128) TOXICOLOGY OF ^{252}Cf. Zalikin, G. A.; Moskalev, Yu. I.; Strel'tsova, V. N.; Zhorova, E. S.; Semenov, A. I.; Petrovich, I. K.; Trifonov, V. I. (Inst. of Biophysics, Moscow). Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Data are presented on accumulation, distribution, and elimination of various compounds of ^{252}Cf from the body of laboratory mammals and characterizes its biological action after a single intravenous injection of acutely, subacutely, and chronically effective doses. Symptoms of acute, subacute, and chronical injury by ^{252}Cf are described and characteristics of its blastogenic efficiency as a function of dose are given. (auth)

27263 (CONF-730907-P1, pp 285-290) INVESTIGATION INTO THE REASONS FOR A LACK OF A TROPHIC LEVEL EFFECT FOR ^{137}Cs IN FUNDULUS HETEROCLITUS AND ITS FOOD IN THE HUDSON RIVER ESTUARY. Mauro, J.; Wrenn, M. E. (New York Univ. Medical Center, NY). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A detailed investigation into the behavior of ^{137}Cs in the food chain of one species of fish (Fundulus heteroclitus) in the Hudson River Estuary revealed the probable reasons for the lack of a trophic level effect for ^{137}Cs in the food chain of Fundulus and perhaps that of most fish in the Hudson River Estuary. A series of laboratory experiments revealed that the elimination rate of ^{137}Cs was $^1/_5$ that of potassium in Fundulus, thereby creating the potential for the trophic level effect. However, since the fish were not in equilibrium with their source of ^{137}Cs and the ability of the fish to assimilate ^{137}Cs relative to that of potassium was markedly reduced due to the presence of sediment in the ingested foods, the trophic level effect did not occur. (auth)

27264 (CONF-730907-P1, pp 725-730) BIOLOGICAL DISPOSITION OF $Es(NO_3)_3$ IN RATS AFTER INTRAVENOUS, INTRAMUSCULAR, AND SUBCUTANEOUS ADMINISTRATION. Smith, V. H. (Battelle Pacific Northwest Labs., Richland, WA). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Adult, female, Wistar-strain rats were injected with 4.76 μCi Es as the nitrate in 0.20 cc pH 2.0 solution (90% ultrafilterable) intravenously (i.v.), intramuscularly (i.m.) and subcutaneously (s.c.). Regardless of the injection route, $Es(NO_3)_3$ was retained preponderantly in the skeleton up to 24 days after administration. The liver burden decreased from 26% of the initial Es administered i.v. at 4 hours to 14% at 1 day and <2% at 24 days. The skeletal content increased to about 70% on day 7 and decreased to about 56% by day 24. The liver and skeletal retention at 24 days from the s.c. and i.m. injections was slightly less than from the i.v. route. Injection site retention was greater for the s.c. route, 16%, than for the i.m. route, 8%. The popliteal lymph nodes adjacent to the i.m. injection site retained about 0.7% of the injected dose/gram compared to about 0.1 that value for the other lymph nodes and routes. Kidney concentrations at 24 days were higher from the i.m. and s.c. routes, 0.56%/g, and 0.43%/g, than from the i.v. route, 0.33%/g and all were higher than the liver concentrations of 0.11 to 0.16%/g wet weight. In common with other actinides, Es was concentrated more in the vertebrae and sternum than in other bones. Excretion was higher initially in the urine, but by the 5th day more was being excreted in the feces. Skin absorption was very high, about 4% of the available Es (2.5 $\mu Ci/cm^2$, pH 2 nitrate solution) being absorbed in 30 min. (auth)

27265 (CONF-730907-P1, pp 743-748) EFFECT OF NATURAL PHYSIOLOGICAL STRESSES AND ARTIFICIAL HORMONAL STRESSES ON THE RETENTION OF AMERICIUM AND PLUTONIUM BY RAT BONE. Hollins, J. G.; Storr, M. C.; Durakovic, A. (National Research Council of Canada, Ottawa). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The retention of intravenously injected ^{241}Am and ^{239}Pu by rat bone varied with age and sex, and during pregnancy and lactation. While the calcium content of bone was substantially reduced by lactation, the retention of americium and plutonium was scarcely affected. When the food consumption of lactating rats was restricted to that of control virgin rats fed ad libitum, the retention of americium by the bone of the lactating mothers was greater than that of the controls. The effect of parenteral administration of parathyroid hormone and a restricted dietary intake of calcium was also to increase the retention of americium at a time when bone calcium was being reduced. In contrast, the retention of americium by rat bone during the intense anabolic period of a mother immediately after lactation was less than that of the controls. The retention of americium and plutonium by bone was also reduced after either a series of intraperitoneal injections of calcium gluconate or parathyroidectomy. (auth)

27266 (CONF-730907-P2, pp 1208-1213) VALIDATION OF THE PRINCIPAL RADIOBIOLOGICAL CHARACTERISTICS OF THORIUM-232 AND ITS DECAY PRODUCTS AND HYGIENIC NORMS (MAAC AND MAD) IN THE ATMOSPHERE OF WORKROOMS. Lyarskii, P. P.; Lavlovskaya, N. A.; Kapitanov, Yu. T.; Elovskaya, L. T.; Makeeva, L. G. Feb 1974. (In Russian).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Rats were administered, intratracheally or by inhalation, with soluble ($^{228}ThCl_4$), insoluble ($^{232}ThO_2$) thorium compounds together with its decay products as well as thorium-232 present in ores. Distribution and retention of Th-232 and its daughters were established for lung, lymph nodes, liver, bone, spleen, kidney, and others. The maximum admissible dose (MAD) was determined for small quantities of thorium inserted in ores. The hygienic norms of thorium-232 and natural thorium (maximum admissible concentration) in atmospheres of workrooms were estimated. (auth)

27267 (CONF-730907-P2, pp 1214-1219) INHALATION STUDY OF A SUBMICRON SIZE LEAD-212 AEROSOL. Bianco, A.; Gibb, F. R.; Morrow, P. E. (Univ. of Rochester, NY). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Dogs (purebred female beagles ~10 kg) were briefly exposed to a submicron aerosol of ^{212}Pb having an effective diffusion diameter between 105 to 120 Å, (σ_g 1.2) produced in a chamber of new design. The resulting lead burden was followed for up to 72 hours postexposure by external counting of the 240 keV gamma ray. The concentration of ^{212}Pb in the arterial and mixed venous blood were regularly measured and no significant A-V difference could be found. The blood concentration data were used to differentiate between the ^{212}Pb level actually in the lungs and that within the thoracic blood volume. This approach was facilitated by the intravenous injection of ^{212}Pb so that an increment in ^{212}Pb concentration in the blood could be correlated with the increment in thoracic radioactivity. Seven canine studies indicated that the submicron aerosol of ^{212}Pb was cleared from the lungs with a single exponential process having a biological half-time of ~12 hours. This mean value corresponds closely to the biological half-times in human lungs reported by other investigators for ^{212}Pb and ^{210}Pb labelled aerosols of diverse physical and chemical forms, viz. 8 to 12 hours, suggesting that the clearance value can be generalized for atmospheric lead. Evidence is presented that the blood is a principal clearance pathway and that external assessment of radioactive lead in the thorax must also consider the lead content of the thoracic wall structures. (auth)

27268 (CONF-730907-P2, pp 1243-1248) BIOLOGICAL MODELING FOR PREDICTING RETENTION PATTERNS OF INHALED CONTAMINANTS. Cuddihy, R. G.; Griffith, W. C.; Boecker, B. B. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Biomathematical models were developed for simulating the tissue distribution and clearance of inhaled Ba and Ce aerosols in beagle dogs. Incorporating physical size characteristics of particles for predicting deposition and chemical solubility for estimating systemic absorption, application of these models was studied over a broad range of aerosol forms. The results illustrate the importance of determining these aerosol characteristics to aid in developing well founded predictions for its biological behavior. Procedures developed to date were more reliable in describing Ba metabolism and illustrate the more complex biochemical nature of Ce retention. (auth)

27269 (CONF-730907-P2, pp 1249-1254) DEPOSITION AND ELIMINATION OF IRON OXIDE AEROSOL FROM THE LUNG OF RATS: COMPARISON WITH ICRP PREDICTIONS FOR MAN. Hewitt, P. J. (Univ. of Bradford, Eng.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Male albino rats have been exposed to iron oxide aerosol (MAD 0.3 μm) at iron concentrations up to 700 mg/m^3 for continuous periods up to 235 min, and for intermediate periods of 30 min over a ten day period. From 0.3 to 3.0 mg of deposited iron were found in the rat lungs removed one day post exposure which corresponds to initial pulmonary fractional depositions of between 0.3 and 0.7 — which is comparable to that proposed for man by the ICRP Lung Dynamics Task Group (0.35). The elimination of deposited iron from the rat lung can be described by a two component exponential expression with parameters similar to those of ICRP for man except that the phase two clearance in rats was found to be shorter ($T^1/_2$ = 33d). (auth)

27270 (CONF-730907-P2, pp 1371-1376) REGULARITIES IN METABOLISM OF RADIOACTIVE ISOTOPES APPLIED TO SKIN. Ilyin, L. A. (Inst. of Biophysics, Moscow). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

This report based on the experimental data and calculated-dosimetric estimates for the first time presents a discussion on the metabolic regularities of radionuclides of the elements of various groups of the Mendeleev periodic system when their solutions are applied to the skin. Common features in the distribution of these agents in the skin irrespective of their chemical origin have been established. Essential differences in the accumulation levels of radioactive substances in the skin and in the level of percutaneous resorbtion have been found. It is shown that transfollicular route is the main way of radionuclide penetration into the body through the skin. (auth)

27271 (CONF-730907-P2, pp 1396-1399) GASTROINTESTINAL ABSORPTION OF ^{144}Ce IN SUCKLING MICE. Feige, Y.; Naharin, A.; Lubin, E.; Sadeh, T. (Soreq Nuclear Research Centre, Yavne, Israel). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The absorption of lanthanides from the gastrointestinal tract is known to be extremely low in adult mammals. Previous studies as well as some recent publications revealed that the absorption of various heavy metal ions, including lanthanides, from the G. I. tract is relatively high during the early stages of life in mice and rats, and decreases gradually during the suckling period. We investigated specifically and quantitatively the variations with age of the absorption of cerium from the G. I. tract in young mice during their suckling period. Post partum albino mice were injected intraperitoneally with $^{144}Ce^{+3}$ citrate at different times during the lactation period. Twenty-four hours after the injection to the mothers, the suckling litters were sacrificed and the ^{144}Ce content in their digestive tract, liver, and carcass determined by gamma counting. The internal deposition via gastrointestinal transfer as determined from the ratio between the ^{144}Ce activities found in the liver and carcass to that ingested with the milk during 24 hours of suckling, was about 4.5% during the first 24 hours of life and about 2% for the whole suckling period. These values, obtained under normal physiological conditions, are about two orders of magnitude above the currently accepted values for gastrointestinal absorption of lanthanides in adult mice, and confirm previous findings regarding the age dependence of the gastro-intestinal absorption of heavy metal ions during the early period of life. Various suggestions put forward to explain these findings are discussed. The assumption that the discriminatory properties of the G. I. tract in mammals are not fully developed at birth seems consistent with all recent experimental findings. (auth)

27272 (CONF-730907-P2, pp 1412-1417) LONG-TERM METABOLISM OF ^{90}Sr IN RHESUS MONKEYS (MACACA MULATTA). Durbin, P. W.; Jeung, N.; Williams, M. H.; Parrott, M. W. (Univ. of California, Berkeley). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The plasma content (R_t) and daily excretion rate (E_t) were measured, and the whole-body retention (R_t) was calculated for 7 to 15 yr after a single injection of ^{90}Sr in young (2.3 to 3 yr), adolescent (3.1 to 5 yr), and adult (>5 yr) rhesus monkeys. Half-times of 6-term exponential equations of P_t and E_t — 0.4 to 0.5 d, 1 to 2 d, 3.5 to 7 d, 40 to 80 d, 300 to 650 d, and 2400 to 3600 d — are similar within each age group and also among the three age groups. The half-times of the first five terms of equations of R_t are similar to those of P_t and E_t, but those of the 6th terms are longer, 4200 to 5600 d, presumably representing redeposition of ^{90}Sr recirculated from remodeled bone. The coefficients of the metabolic equations demonstrated greater early ^{90}Sr excretion by the older monkeys and greater late retention of ^{90}Sr by the growing monkeys. When age at injection was considered, ^{90}Sr retention in monkeys agreed with retention of ^{85}Sr or ^{90}Sr in other simians, beagles, and human adults. (auth)

27273 (CONF-730907-P2, pp 1418-1421) STUDY OF THE TRANSLOCATION OF RADIOSTRONTIUM FROM WOUNDS AND THERAPY BY LOCAL INSOLUBILIZATION. Ducousso, R.; Causse, A.; Pasquier, C. (Groupe de Recherche du Service de Sante des Armees, Fontenay-aux-Roses, France). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The translocation of ^{85}Sr was followed by a 2 h external counting of the wound and homologous bone and by measurement of the blood radioactivity. Two types of wounds were simulated on Maccacus monkeys: puncture wounds and lacerations. The same experimental procedure was applied in order to test therapy through Sr insolubilization by rhodizonate (K), $MgSO_4$, alginate (Ca), and aluminium phosphate gel, on laceration wounds either 5 or 15 min after the contamination. It was verified that local or IV administration of DTPA did not result in an increased absorption of Sr. (auth)

27274 ^{67}Ga-UPTAKE IN THE REGENERATING RAT LIVER. Hill, J. H.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore). J. Nucl. Med.; 15: No. 9, 818-820(Sep 1974).

Gallium-67-citrate accumulation in the regenerating liver of the partially (67%) hepatectomized rat was measured 4 hr after surgery and 8 hr following injection of the tracer. After 24 hr, the weight of the remaining liver increased 57.3 ± 7.6 (se) % compared with the corresponding portion of the liver of a sham-operated control rat. The ratio of ^{67}Ga uptake per gram liver in the partially hepatectomized rat to that in the paired control animal was 0.99 ± 0.08 (se). These findings suggest that ^{67}Ga uptake is not related to hepatic cell proliferation associated with regeneration. (auth)

27275 THE EFFECT OF CARBON TETRACHLORIDE ON RADIOCERIUM METABOLISM IN RATS. Trnovec, T.; Pleskova, A.; Chorvat, D. (Vyskumny Ustav Hygieny Prace a Chorob z Povolania, Bratislava (Czechoslovakia)). Strahlentherapie; 147: No. 5, 521-530(May 1974).

5 figs.; 33 refs.

Carbon tetrachloride only slightly affected the rate of colloidal carbon removal from blood of rats. The clearance of ^{144}Ce at pH = 3 in rats with toxic hepatic injury was decreased, and a return to normal rates was observed approximately 7 days after application of carbon tetrachloride. Lower hepatic uptakes of ^{144}Ce at pH = 3 and ^{144}Ce at pH = 8 were observed simultaneously with an increase of their content in the spleen and lungs. No relationships were found between the decreased level of ^{144}Ce in liver and alterations of the glycogen content in the liver and of bromsulphalein clearance. Conclusions about the role of liver parenchymal cells in initial hepatic uptake of radiocerium were drawn. (auth)

27276 EARLY PHASES OF ^{239}Pu METABOLISM AFTER PERORAL ADMINISTRATION IN THE ANIMAL ORGANISM. Necev, H. Rentgenol. Radiol.; 12: No. 3, 171-174(1973).

The early phases of plutonium-239 metabolism, after peroral administration in the form of $PuCl_3$ are discussed. The skeletal type of radionuclide distribution in the organism is emphasized. The coefficient of radioisotope absorption by the gastrointestinal tract was determined according to an original technique by administering the radionuclide in the portal vein, which enables to demonstrate the barrier function of the liver and to obtain more exact results. Plutonium-239 absorption coefficeint determined according to the author's technique differs by 22% from the one determined by the hitherto used technique. (auth)

27277 MEDICAL PRIMATOLOGY 1972. Part III. Infectious Diseases, Oncology, Pharmacology and Toxicology, Cardiovascular Studies. Third Conference on Experimental Medicine and Surgery in Primates, Lyon, France, June 21-23, 1972. Goldsmith, E. I.; Moor-Jankowski, J. (eds.). Basel; S. Karger AG (1972). 406p. (CONF-7206103-P3). $43.40.

From third conference on experimental medicine and surgery in primates; Lyon, France (Jun 1972).

Separate abstracts were prepared for two of the 144 papers included. Other papers discuss infectious diseases, viral oncology, pharmacology and toxicology, cardiovascular studies, the breeding of laboratory animals, reproduction and perinatal studies, genetics, experimental surgery, oral medicine, and neurophysiology. (CH)

For abstracts of individual papers see: 27278 and 27334.

27278 BABOON AS AN EXPERIMENTAL ANIMAL FOR METABOLIC STUDIES OF BONE-SEEKING RADIONUCLIDES IN MAN. Cohen, N.; Wrenn, M. E. (New York Univ., NY). pp 226-236 of Medical Primatology 1972. Part III. Goldsmith, E. I. (ed.). Basel; S. Karger AG (1972).

From third conference on experimental medicine and surgery in primates; Lyon, France (Jun 1972). See CONF-7206103-P3.

The tissue distribution of ^{210}Pb and ^{241}Am was studied in baboons (Papio anubis) following intravenous injection of $^{210}PbCl_2$ or ^{241}Am citrate. Whole-body, organ, and skull activity measurements were made at various times using a scintillation counter. Samples of blood, hair, feces, and urine, and liver and spleen biopsies obtained at various times were analyzed, autoradiograms of bone samples were examined, and soft tissue and bone samples obtained at autopsy were counted for radioactivity. (CH)

27279 INCORPORATION OF TRITIUM FROM TRITIATED WATER INTO NUCLEIC ACIDS OF ORYZIAS LATIPES EGGS. Ueno, A. M. (National Inst. of Radiological Sciences, Chiba, Japan). Radiat. Res.; 59: No. 3, 629-637(Sep 1974).

Eggs of Oryzias latipes were kept at 25°C in tritiated water (HTO) from a few hours after fertilization to the day before hatching (9 days). When eggs were kept at 25°C in 10 μCi/ml of HTO, a radioactivity of $46.8 \pm 5.72 \times 10^{-4}$ μCi/wet egg was found at an equilibrium activity level, whereas the dry egg contained only about 1% of the radioactivity of the wet egg. The radioactivity of tritium in nucleic acids (DNA plus RNA) isolated from eggs incubated with 10, 100, and 1000 μCi/ml of HTO was closely proportional to HTO concentrations. Tritium in DNA isolated from the eggs treated with 100 μCi/ml of HTO had a specific activity of 8.48 μCi/g matter. The DNA radiation dose was esti-

mated to be approximately 2.4 rads/day DNA. The experiment of the DNA separation into individual bases revealed that all four bases, but especially thymine, were labeled. Incorporation of tritium into both DNA and RNA was observed at the same stages at which these macromolecules were synthesized during embryogenesis. After the transfer of the tritiated eggs into tritium-free water, subsequent incubation indicated that the loss of tritium from the DNA of the eggs was very slow. (auth)

27280 DECORPORATION OF RADIONUCLIDES. On the So-Called Sustained Action of DTPA. Planas-Bohne, F. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Strahlenbiologie). Strahlentherapie; 147: No. 3, 315-318(Mar 1974). (In German).

2 figs.; 20 refs.

The influence of DTPA on the retention of ^{144}Ce in liver and skeleton was studied in rats. DTPA was injected either together with ^{144}Ce (in different DTPA-dosage) or at different times before ^{144}Ce. The results did not confirm the assumption that the DTPA-fraction excreted slowly from the blood plasma is responsible for the sustained action of DTPA. (auth)

27281 LONG-TERM TREATMENT OF CESIUM 137 CONTAMINATION WITH COLLOIDAL AND A COMPARISON WITH INSOLUBLE PRUSSIAN BLUE IN RATS. Mueller, W. H.; Ducousso, R.; Causse, A.; Walter, C. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Strahlentherapie; 147: No. 3, 319-322(Mar 1974).

1 fig.; 3 tabs.; 10 refs.

Wistar rats of about 250 g were injected s.c. by 1 ml of a solution containing 17 ωCl ^{137}Cs, 0.1 mg stable CsCl and 0.9% NaCl. One group received insoluble prussian blue ($Fe/Fe(CN)_6$ = 1.33), another group colloidal prussian blue ($Fesup(III)/Fe(CN)_6$ = 1.00), and the third one served as a control. It was shown that the long-term treatment with the dialysed soluble colloidal prussian blue does not provoke a Cs retention in the RES especially not in the liver. In short as well as in prolonged treatments the decontamination effect of colloidal prussian blue is obviously better than that of the insoluble one. The preparation of the cleaned prussian blue is given. (GE)

27282 INVESTIGATIONS ON THE $^{90}Y:{}^{90}Sr$ RELATION IN THE SKELETON OF RATS AFTER INCORPORATION OF ^{90}Sr AS A FUNCTION OF VARIOUS PARAMETERS. Stevenson, A. F. G. Feiburg, Ger.; Feiburg Univ. (1973). 128p. (In German). INIS.

Thesis. 19 figs.; 48 tabs.; 96 refs. With abstract. Available from the Freiburg Univ. library.

Albino rats of the Heiligenberg strain received i.v., i.p., i.m., or s.c. injections of a solution of ^{90}Sr, which was in radioactive equilibrium with its daughter product ^{90}Y. Results of the studies show that transport and incorporation of ^{90}Y in the bone is best when the pH value of the solution injected is about 7, which is approximately that of the tissue fluid. The different ways of injecting the $^{90}Y-{}^{90}Sr$ solution resulted in different Y:Sr activity ratios, with the values obtained decreasing in the order i.v., i.p., i.m., and s.c. injection. Moreover, some hormones contributing to the control of the mineral balance of the organism were found to have a strong influence on the distribution of ^{90}Sr and ^{90}Y in the body. Thus the Y:Sr activity ratio is higher in female animals than in males and increases with age. This effect is due to the influence of the female sex hormone and the growth hormone. Further experiments with parat hormone and corticosteroids showed that these substances, too, affect the Y:Sr activity relation. As the skeleton is the critical organ system with regard to these two radionuclides, the main radiation damage is expected to be found in the bone marrow. In order to get an idea about energy doses and dose rates in the medullary canal after incorporation of ^{90}Sr and ^{90}Y, measurements were made by means of the thermoluminescence of LiF. (GE)

Microorganisms

27283 ATTEMPT TO BIOSYNTHESIZE ^{123m}Te-TELLUROMETHIONINE. Kolar, Z. (Interuniversitair Reactor Instituut, Delft, Netherlands). Int. J. Appl. Radiat. Isotop.; 25: No. 7, 330-331(Jul 1974).

^{75}Se-selenomethionine can be obtained from the protein fraction of yeast grown on a low-sulfur medium to which ^{75}Se-selenite was added. The feasibility of this biosynehetic procedure for the preparation of ^{123m}Te-telluromethionine was investigated. The results indicate that the biosynthetic procedure as described for ^{75}Se-L-selenomethionine production (Blau, Biochim. Biophys. Acta.; 49: 389 (1961)) cannot be applied for the preparation of significant amounts of labelled telluromethionine. Other mechanisms, rather than incorporation of tellurium into amino acids and proteins, are responsible for the major part of the observed uptake of tellurium by growing yeast. These mechanisms are reduction of tellurite to elemental tellurium (followed by deposition of it within the cells) and probably the adsorption of tellurite ions on the surface of the yeast cells. (UK)

New Tracer Techniques

Refer also to abstracts 26806, 26867, 26873, 27124, 27158, 27196, 27256, and 28884.

27284 (CNEA-EN-35/107) THEORETICAL PRINCIPLES OF RADIOIMMUNOASSAY. Cembal, S. J.; Valles, R. E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). May 1973. 37p. (In Spanish). INIS.

From the definition of a base model, the general law controlling the saturation analysis for the determination of molecules and particularly in radioimmunoassay $R^2 + R(1 + Kp + Kp^* - Kq) - Kq = 0$ is deduced. In the equation R is the relation of the unit activity to the free activity (relation known as B/F); K is the equilibrium constant; p is the concentration of the chemical species to be determined; p^* is the chemical species to be determined labelled with a radioactive isotope; and q is the concentration of the specific reagent for p. From this same basic model another mathematical expression $R = Kq - K(B)$ is derived which allows the calculation of the equilibrium constant and the concentration of the specific reagent and the observation of the behavior of the system with respect to the law of mass action. R is the relation B/F; (B) is the concentration of the unit chemical species p to the specific reagent q and K is the equilibrium constant of the system. Distinct types of dose-response curves for theoretical changes of K, p^*, and q are analyzed. The result of the analysis gives the optimum conditions of the reagents for a high sensitivity system. These conditions are $p^* = 4/K$, $q = 3/K$, and $p^* = 2(q - 1/K)$. In order to verify the stability, precision, and reproducibility of radioimmunoassay and to determine the confidence limit of an estimated dose, a simple statistical study appropriate for this type of analysis was presented. From this study the criterion to realize quality control of radioimmunoassay was adopted. (tr-auth)

27285 (CONF-740708-4) PRINCIPAL COMPONENTS: A NEW APPROACH TO THE ANALYSIS OF GASTRIC EMPTYING. Barber, D. C.; Duthie, H. L.; Howlett, P. J.; Ward, A. S. (Royal Infirmary, Sheffield (UK)). 1973. 8p. (SM-185/10). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee USA (15 Jul 1974).

Digitized activity-time curves from gastric emptying studies with a gamma camera following ingestion of a meal consisting of meat, peas, and mashed potatoes labeled with 1 mCi ^{113m}In can best be represented by the principal components of the curves. These principal components can be used to construct a model for each curve, which is a much better fit to the original data, as measured by the statistical criterion of goodness of fit, than a single exponential model. The emptying curves of patients from the same clinical population exhibit similar principal components, which distinguish them from other clinical groups. So that, for example, the control patient group can be distinguished from the group of patients with duodenal ulcer. The implication of this separation between groups is that differences in the pattern of gastric emptying, which are detected by the principal component analysis, have physiological causes. Further it may be possible to isolate the nature of these causes by inducing changes in pattern with known stimuli. (auth)

27286 (CONF-740708-39) APPLICATION OF A MULTI-IMAGING SYSTEM TO DYNAMIC SCINTISCANNING USING POLAROID POSITIVE/NEGATIVE FILM. Rudavsky, A. Z. (Morrisania City Hospital, Bronx, N. Y. (USA). Nuclear Medicine Lab.). 1974. 4p. (SM-185/27). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The use of a multi-imager unit with Polaroid positive/negative film to yield high quality gamma camera dynamic scintigraphic studies is described. In contrast to other techniques, the system is essentially free of dead-time between images. The finished film and print are ready for inspection within seconds following the completion of the study. (auth)

27287 (IAEA-R-293-F) STUDIES ON THE NUTRITION OF COCONUT PALM. Part of a Coordinated Programme of Research

on the Study of Efficient Use of Fertilizers in Tree Culture. Final Report, 1 April 1964–31 December 1972. Alcala, P.; Valencia, I. G.; Verano-Brewbaker, L.; Santos, I. S. (International Atomic Energy Agency, Vienna (Austria)). Oct 1973. vp. INIS.

Using a ^{32}P soil injection technique, a series of field experiments were carried out in the Philippines to study the intensity and distribution of root activity of young (10 to 15 year old) and mature (50 to 60 year old) coconut palms (variety laguna, a typica) in order to determine the best zones and times for fertilizer application. The experiments were carried out in both wet and dry seasons on sandy loam and clay loam soil types on trees planted at a spacing of 700 × 700 cm. The ^{32}P content of leaflets sampled from a recently matured frond (6th frond) was used as a measure of root activity. Both in the case of the young and mature trees, and on both soil types, highest individual tree root activity was observed to be in the wet season, at a depth of 15 to 30 cm and distances of 100 cm and 200 cm from the tree. Other distances tested were 300 and 400 cm. In the dry seasons, the intensity of root activity was considerably lower, and there was a higher density of active roots at depths of 30 to 60 cm farther away from the tree, and also at 15 to 45 cm depths at a distance of 100 cm. In experiments with ^{32}P labelled superphosphate fertilizer to study the efficiency of fertilizer uptake by the plantation as a whole, the ^{32}P uptake by both the ^{32}P treated tree and the border trees surrounding it was studied. When fertilizer was applied at 50 cm and 100 cm distance from the tree in a strip parallel to the rows of trees the fertilizer was observed to be equally available to both the treated tree and border trees which were 600 to 800 cm away from the fertilizer strip. The results indicate that the tree roots are equally active in close proximity to the tree (50 cm to 100 cm) and also at a considerable distance away (600 to 800 cm) at 15 cm depth. The highest activity for an individual tree was at 100 to 200 cm distance at 15–30 cm depth, while activity at the 300 and 400 cm distances was comparatively less. High fertilizer uptake by the plantation as a whole can be achieved by fertilizer application within the 50 cm to 200 cm zone. However, further experimentation with labelled fertilizers is required for confirming this and more precise definition of the optimum zones for fertilizer application. (INIS)

27288 (IAEA-R-523-F) FERTILIZER EFFICIENCY STUDIES IN GRAIN CROPS IN RELATION TO MOISTURE CONDITIONS. Part of a Coordinated Programme on Wheat Fertility, using Fertilizer Containing Labelled Nutrient Elements. Final Report, 10 May 1967–31 August 1972. Dombovari, J. (International Atomic Energy Agency, Vienna (Austria)). Jan 1973. 6p. INIS.

The effect of nitrogen and phosphorus fertilizers in alluvial clay loam meadow soil was studied by means of ^{15}N. Soil moisture content was determined by a neutron probe, and the amount of irrigation water needed was calculated. N fertilizers had a positive effect on yield and N content of wheat. The examined fertilizer sources (NH_4NO_3, urea, ammonium sulfate, and diammonium-phosphate) increased the yield significantly. Optimal dose ranges were established. The percentage of N derived from fertilizers ranged from 35 to 47, depending on the N source and time and method of fertilizer placement. Fertilizer application and irrigation could not be correlated. (INIS)

27289 (IAEA-R-851-F) APPLICATION OF IN VITRO RADIOISOTOPE TECHNIQUES IN STUDIES ON THE ENDOCRINE STATUS OF THE NIGERIAN. Final Report, 1 December 1969–30 November 1972. Adadevoh, B. K. (International Atomic Energy Agency, Vienna (Austria)). Jan 1973. vp. INIS.

Insulin, human chorionic somatomammotropin (HPL) and oestradiol were determined by radioimmunoassay. Plasma cortisol and tri-iodothironine (T_3) were measured by saturation analysis. High fasting levels of insulin, which may be related to the high carbohydrate diet, were obtained in adults (22.0 ± 1.9 μU/ml), in pregnancy (18.5 ± 0.94 μU/ml) and in children (15.6 ± 0.71 μU/ml). No increase in plasma insulin level was observed with age. A delayed maximal insulin response was observed after oral glucose load. The peripheral insulin response to three sulphonylureas paralleled their therapeutic potency, thus reflecting an adequate pancreatic response to these drugs following glucose challenge. The radioimmunoassay of plasma insulin was instrumental in confirming the diagnosis in two cases of insulinoma. HPL levels in pregnancy ranged from 3.2 to 11.3 μg/ml in the second trimester and from 9.3 to 27.1 μg/ml in the third trimester. Problems with the radioimmunoassay of oestradiol were encountered, probably due to low affinity of the rabbit antisera obtained by injection of oestradiol–succinyl-bovine serum albumin to the antigens employed, e.g., oestradiol, oestrone and testosterone. The results of plasma cortisol binding tests performed with samples obtained during insulin hypoglycaemic stress suggested an increase in non-protein bound cortisol at the height of the hypoglycaemic stress, before a maximal rise in plasma cortisol occurred. A Sephadex T3-uptake test developed in the contractor's laboratory compared favorably with the Thyopac-3 T3-uptake test (Radiochemical Center, Amersham), but the values obtained were low. By means of the in-vitro procedures established, it will also be possible to follow endocrine changes in kwashiorkor, control the use of contraceptives and measure the secretion of insulin in cases of lactose intolerance. (INIS)

27290 (ORAU-123, pp 55-89) RESEARCH IN NUCLEAR MEDICINE. 1973.

In 1973 research report for year ending December 31, 1973.

Experimental work in radiopharmaceutical development has emphasized the higher-atomic-number rare-earth radionuclides which have tumor-localizing propensities. Nuclides of thulium, erbium, and dysprosium have been studied extensively in animals with transplanted tumors. It appears that these nuclides may compare favorably with ^{67}Ga in tumor-localizing potential. Their distribution is essentially complete by 4 hr after injection, but they concentrate in bone and kidney more than does ^{67}Ga. For best results it will be necessary to use high-specific-activity nuclide preparations. Related nuclides that are mainly β-emitters may have some potential value as therapeutic agents. A trial made with ^{253}Es showed that it had a significant concentration in animal tumors. Animal studies have shown the possibilities of an improved marrow-scanning agent with radiogold. Gold-199 was demonstrated as preferable to ^{198}Au because the former gives less radiation dose per useful photon and because its emissions have an energy more suitable for imaging with the gamma camera. Further progress was made in animal studies on the radioprotective drug WR-2721, which may possibly enhance the relative effectiveness of radiotherapy on tumors as compared with normal tissues. Centrifugation studies showed that ^{167}Tm and ^{111}In have a distribution in cell fractions similar to that of ^{67}Ga. Another tumor-localizing nuclide, ^{206}Bi also localizes mainly in cytoplasmic fractions, but in a pattern quite different from that of ^{67}Ga. The macromolecular binding of ^{67}Ga in thymus is similar to that of tumor tissue in contrast to that seen in other normal tissues. In a clinical study, ^{67}Ga and ^{111}In were compared by giving the two nuclides simultaneously to a small group of patients. Later scans made with energy selection helped to show the relative distribution of the two, and in those instances where surgical material was available a satisfactory quantitative differential counting method was developed. A strong tumor uptake was demonstrated in only one of three patients, and in this case the ^{67}Ga uptake was far superior to that of ^{111}In. (CH)

27291 RADIOIMMUNOASSAY OF GROUP I PEPSINOGENS IN SERUM. Samloff, I. M.; Liebman, W. M. (Harbor General Hospital, Los Angeles). Gastroenterology; 66: No. 4, 494-502 (Apr 1974).

A radioimmunoassay for the group I pepsinogens (PG I) in human serum has been developed. The standard PG I was isolated from human urine, and, when labeled with ^{125}I, was shown to be immunochemically homogeneous by radioimmunoelectrophoresis and radioimmunoprecipitation. The antiserum was obtained from rabbits immunized with partially purified PG I. Standard PG I and serum give parallel inhibition curves against the labeled antigen. The sensitivity of the assay is in the order of 2 ng per ml of serum. The reproducibility of the determinations was demonstrated. PG I in serum is stable when stored at −20°C for at least 7 months. The mean (±SD) serum PG I levels in 69 healthy control subjects and in 71 hospitalized control patients were 102.7 ± 32.5 and 96.2 ± 41.9 ng per ml, respectively. In 14 patients with pernicious anemia and in 12 patients with total gastrectomy, mean serum PG I levels were 10.2 ± 6.4 and 3.8 ± 2.9 ng per ml, respectively. In 5 patients with Zollinger–Ellison syndrome, the mean level was 456.1 ± 187.3 ng per ml. (auth)

27292 HEPATIC WASHOUT CURVES OF ^{85}Kr AND ^{133}Xe AFTER RETROGRADE HEPATIC VENOUS INJECTIONS IN PATIENTS WITH INFECTIOUS HEPATITIS AND IN CONTROLS. Lundbergh, P. (Roslagstull Hospital, Stockholm); Strandell, T. Scand. J. Clin. Lab. Invest.; 33: No. 3, 277-285(May 1974).

In 8 patients with infectious hepatitis and in 10 controls the disappearance rates of ^{85}Kr and ^{133}Xe were measured externally after labeling hepatic tissue by retrograde simultaneous hepatic venous injections of the isotopes. As xenon has a higher affinity for fat than krypton, the quotient between the halftime for ^{85}Kr and for ^{133}Xe could be used for calculation of hepatic fat content as well as the partition coefficients of the isotopes between hepatic tissue and blood. The estimated hepatic fat content was significantly higher in the patients than in the controls, 5.8 versus 3.6 percent. The calculated partition coefficients in the controls were 1.09 and 1.13, respectively, for krypton and xenon. The corresponding

values in the patients were significantly higher, 1.25 and 1.41, respectively. The clearances of the isotopes seemed to overestimate the average perfusion coefficient by 25 percent, as judged from total hepatic blood flows and expected liver weights. A possible explanation might be local hyperemia in the injected areas. The present data indicate that this method can be used to estimate partition coefficients and hepatic fat content. (auth)

27293 SIMULTANEOUS ABSORPTION TEST OF HUMAN INTRINSIC FACTOR (IF) BY BOUND ^{57}Co-VITAMIN B_{12}(B_{12}) AND FREE ^{58}Co-B_{12}. Nakajima, T.; Abe, T.; Okamura, H.; Komiya, M. (Tokyo Medical and Dental Univ.). Rinsho Ketsueki; 15: No. 3, 291-297(Mar 1973). (In Japanese).

A urinary B_{12} excretion test by dual isotope techniques was performed in 22 patients including 7 with pernicious anemia, 3 with total gastrectomy, and 2 with chronic renal failure. The urinary excretion rate of ^{58}Co-B_{12} was 21.3 ± 3.7% in control group and 4.1 ± 2.6% in both patients with pernicious anemia and those with total gastrectomy. The ratio of ^{57}Co-B_{12} to ^{58}Co-B_{12} was significantly high (p 0.01), ranging 1.4 to 9.4 in the patients with intrinsic factor (IF) deficiency. In this group, the percent excretion of ^{58}Co-B_{12} was greater than that of free B_{12} only when administrated to the same patient. Free IF was not found in the solution of IF bound ^{57}Co-B_{12} and 8 to 15% of ^{57}Co-B_{12} was free from IF by coated charcoal method. The exchange of ^{57}Co-B_{12} on IF with free B_{12} occurred depending on pH and temperature in vitro. Therefore, the higher urinary excretion of the free form of B_{12} in the dual isotopic method was probably due to the exchange of two forms of B_{12} in vivo. The radioactivity of ^{58}Co-B_{12} in 2 ml of urine is too low to be measured accurately. This was determined by counting ^{58}Co-B_{12} adsorbed on uncoated charcoal from 20 ml of urine. (auth)

27294 HIGH RESOLUTION RADIOAUTOGRAPHY. Simon, G. T.; Bedard, Y. C. (Toronto Univ.). Can. Res. Develop.; 7: No. 3, 20-22; 40(May 1974).

The technique of electron-microscope autoradiography is briefly reviewed, and illustrated by autoradiographs of the absorption of ^{55}Fe by mouse duodenum. The absorptive epithelial cells at the tip of the duodenal villi can clearly be seen as deep black shapes. Measurements showed loss of ^{55}Fe during processing to be quite small. Statistical calculations show that iron is concentrated in the ribosomes, Golgi bodies, terminal webs and lateral cell membranes. (CA)

27295 PHYSIOLOGY OF THE SPLEEN (HYPERSPLENISM) FROM THE ISOTOPIC POINT OF VIEW. Yvart, J. (Centre Hospitalier Univ., Creteil, France). Ann. Gastroenterol. Hepatol.; 10: No. 2, 124-156(Feb 1974). (In French).

The use of radioisotope techniques in the study of splenic functions and, particularly, in cases of hypersplenism is discussed. The function of uptake of blood cells, duration of life of the red cells, platelets, and granular leukocytes is studied. The function of filtration by scintigraphic techniques and especially dynamic investigations using labelled red cells partially destroyed by heating is studied. (FR)

27296 DETECTION OF OBSTRUCTIVE PULMONARY DISEASE. Alderson, P. O.; Secker-Walker, R. H.; Forrest, J. V. (Washington Univ., St. Louis). Radiology; 112: No. 3, 643-648(Sep 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

A double-blind evaluation of the chest radiographs and ventilation-perfusion scans of 160 patients was performed to assess their relative sensitivity in detecting obstructive airway disease. In 76 the initial scan diagnosis was obstructive pulmonary disease; 35 of these showed no radiographic evidence of COPD. The abnormalities in these 35 were significantly milder than in the 41 others. Perfusion scans were normal in 7 patients with mild disease and normal radiographs. Regional ventilation studies are helpful in evaluating cases of mild to moderate airway obstruction that would be misdiagnosed by radiographs or perfusion scans alone. (auth)

27297 CARDIAC SHUNT ASSESSMENT IN CHILDREN WITH MACROAGGREGATED ALBUMIN TECHNETIUM-99m. Gates, G. F.; Orme, H. W.; Dore, E. K. (Memorial Hospital Medical Center, Long Beach, CA). Radiology; 112: No. 3, 649-653(Sep 1974).

Right-to-left cardiac shunting is calculated following intravenous administration of macroaggregated albumin (MAA) tagged with ^{99m}Tc. MAA entering the pulmonic circuit lodges in its capillary bed while that bypassing the lungs is impacted in the systemic circuit. A total body count is obtained with a gamma camera. Lung activity is measured separately. From these activity counts, the magnitude of right-to-left cardiac shunting is determined. (auth)

27298 PROPOSED MECHANISM FOR ^{99m}Tc-LABELLED POLYPHOSPHATE AND DIPHOSPHONATE UPTAKE BY HUMAN BREAST TISSUE. Schmitt, G. H.; Holmes, R. A.; Isitman, A. T.; Hensley, G. T.; Lewis, J. D. Radiology; 112: No. 3, 733-735 (Sep 1974).

Local uptake of ^{99m}Tc-polyphosphate or ^{99m}Tc-diphosphonate by breast tissue was observed in 17 patients, occurring in normal breasts and also in benign and malignant breast lesions. Large concentrations of acid phosphatase were demonstrated histochemically in bone and in breast tissue of lactating rats and in human breast cancers. It is therefore proposed that focal uptake of polyphosphate and diphosphonate in bone and in soft tissues may be due to their binding to receptor sites on enzymes such as acid phosphatase. (auth)

27299 SOME APPLICATIONS OF SCINTISCANNING TO RADIATION THERAPY. Feldman, M. I.; Anderson, B. G.; Shetty, S. K. (University Hospital, Boston). Radiology; 112: No. 3, 740-741(Sep 1974).

Simple localization techniques are described which combine the technology of nuclear medicine and the clinical needs of beam direction treatment planning in supervoltage radiation therapy. Although they are not a substitute for simulation, they do have certain advantages over radiographic methods. None require more than ten minutes once the routine has been established and all necessary equipment made readily available. (auth)

27300 CONCENTRATION OF ^{99m}Tc DIPHOSPHONATE IN BREAST TISSUE. McDougall, I. R.; Pistenma, D. A. (Stanford Medical Center, CA). Radiology; 112: No. 3, 655-657 (Sep 1974).

Increased concentration of ^{99m}Tc diphosphonate was seen in the breast tissue of 5 patients undergoing bone scans. In one patient, the radiopharmaceutical localized in an advanced primary breast tumor whereas in the other 4, concentration was in normal breast tissue. Accumulation of ^{99m}Tc diphosphonate in breast tissue does not indicate breast cancer. (auth)

27301 NONSPECIFICITY OF GALLIUM ACCUMULATION: GALLIUM-67 CONCENTRATION IN CEREBRAL INFARCTION. Reba, R. C.; Poulose, K. P. (George Washington Univ., Washington, DC). Radiology; 112: No. 3, 639-641(Sep 1974).

Carrier-free gallium-67 citrate has been useful in the detection of a wide variety of soft-tissue malignancies such as lymphomas and carcinomas. This radionuclide was investigated to determine its usefulness in differentiating intracerebral tumor from stroke. A study was done on twelve stroke patients and gallium-67 was found to be nonspecific in its ability to differentiate cerebral infarction from cerebral tumor. (auth)

27302 SCINTIGRAPHIC FEATURES OF THE OCCIPITAL SINUS. Go, R. T.; Suzuki, Y.; Schapiro, R. L.; Christie, J. H. (Univ. of Iowa, Iowa City). Radiology; 112: No. 3, 635-638(Sep 1974).

The occipital sinus could be identified in 190 (76%) of 250 brain scans. A midline single sinus was observed in 163 cases (86%), a double sinus in 17 (9%), and a laterally deviated sinus in 10 (6%). The relative width of the sinus as well as its course and intensity of activity are discussed. Correct diagnosis of posterior fossa lesions requires appreciation of the variability of appearance of the occipital sinus on brain scans. The value of posterior stereoscanning is emphasized. (auth)

27303 AUGMENTED SPLENIC UPTAKE OF ^{99m}Tc-SULFUR COLLOID IN PATIENTS WITH MALIGNANT MELANOMA. Goldman, A. B.; Braunstein, P. B.; Song, C. (New York Univ., NY). Radiology; 112: No. 3, 631-634(Sep 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Liver scans of 63 consecutive patients with malignant melanoma were reviewed for augmented splenic uptake of ^{99m}Tc-sulfur colloid in the absence of hepatic abnormality, e.g., focal lesion(s) or liver enlargement on the scan, clinical indications of liver abnormality at or since the time of examination, or abnormal liver chemistries. Of 22 such patients with malignant melanoma, 10 showed augmented splenic radioactivity. 60 patients with carcinoma of various sites and no suspicion of liver involvement were used as controls. Augmented splenic activity associated with malignant melanoma should be considered when interpreting liver scans. (auth)

27304 STUDIES OF TANTALUM DUST IN THE LUNGS. Bianco, A.; Gibb, F. R.; Kilpper, R. W.; Landman, S.; Morrow,

P. E. (Univ. of Rochester, NY). Radiology; 112: No. 3, 549-556(Sep 1974).

Studies of tantalum dust labelled with ^{182}Ta in dogs following either inhalation or insufflation exposures demonstrated that the alveolarization of tantalum dust leads to prolonged retention, viz., a mean biological removal half-time greater than two years; mucociliary transport, the dominant clearance mechanism, was somewhat longer than that reported for other insoluble dusts and apparently independent of the absolute amount of tantalum present; the minimal surface density suitable for clinical bronchography is of the order of 10 mg tantalum/cm^2 of bronchial surface; and radiographic assessments of either airways or alveolar areas cannot utilize a surface deposition of ≤5 mg/cm^2 tantalum and therefore are of limited value in quantitative applications, e.g., absolute tantalum retention. (auth)

27305 USE OF ^{123}I FOR THYROID UPTAKE MEASUREMENTS AND DEPRESSION OF ^{131}I THYROID UPTAKES BY INCOMPLETE DISSOLUTION OF CAPSULE FILLER. Robertson, J. S.; Verhasselt, M.; Wahner, H. W. (Mayo Clinic, Rochester, MN). J. Nucl. Med.; 15: No. 9, 770-774(Sep 1974).

Iodine-123 for thyroid iodine uptake measurements was evaluated by a method which allows simultaneous measurements of ^{131}I and ^{123}I. It was found that thyroid uptake measurements made with ^{131}I capsules from one commercial supplier gave consistently lower thyroid uptake values (in the order of 30% less) than simultaneous measurement of uptakes with ^{123}I capsules. The reason was traced to a delayed absorption of ^{131}I from capsules containing a Gelfoam filler. (auth)

27306 COMPUTER-ASSISTED SCANNING IN EVALUATION OF ^{67}Ga-CITRATE UPTAKE IN THYROID DISEASE. Erjavec, M.; Auersperg, M.; Golouch, R.; Snajder, J.; Turnsek, T. (Inst. of Oncology, Ljubljana, Yugoslavia). J. Nucl. Med.; 15: No. 9, 810-813(Sep 1974).

Fifty-two patients having thyroid nodules were investigated with ^{67}Ga-citrate in conjunction with scintillation scanning in order to assess its value for the preoperative diagnosis of malignancy. It was found that conventional images are equivocal and difficult to interpret. Therefore, a computer method was devised by means of which the uptake of various neck structures was expressed in terms of body-background counting rate thus producing an image of apparent target/nontarget ratios. By means of this method, it was demonstrated that radiogallium concentrates in a variety of normal and pathological neck structures, the range of ratios being roughly 1.5 to 2.5. The diagnostic power of the procedure was found to be low except in four patients with anaplastic carcinoma which invariably showed high concentrations of ^{67}Ga. The highest uptake of this agent was found in a case of Hashimoto's disease (5.2). (auth)

27307 EFFICIENT METHOD FOR FRACTIONAL LABELING OF MICROSPHERES. Wieland, H. C.; Grames, G. M.; Jansen, C.; Davidson, T. (Loma Linda Univ. Medical Center, CA). J. Nucl. Med.; 15: No. 9, 808-809(Sep 1974).

The introduction of human albumin microspheres (HAM) is a significant advance in carrier-protein technology for the study of capillary perfusion. However, the recommended labeling procedure is an expensive and inefficient method for the utilization of microspheres and ^{99m}Tc. A procedure is outlined for the fractional labeling of HAM with ^{99m}Tc. This provides a simple, efficient, and economical use of microspheres and technetium allowing for high specific activity particles. It is particularly applicable to nuclear medicine departments with a relatively small patient load. (auth)

27308 SURVIVAL AND SEQUESTRATION OF ^{51}Cr- AND $^{99m}TcO_4$-LABELED PLATELETS. Uchida, T.; Yasunaga, K.; Kariyone, S.; Wakisaka, G. (Kyoto Univ.). J. Nucl. Med.; 15: No. 9, 801-807(Sep 1974).

A new method by which blood platelets can be labeled with ^{99m}Tc and ^{51}Cr is presented. Platelets separated by Aster's acid-citrate method were incubated with ^{99m}Tc and ^{51}Cr followed by reduction with stannous chloride ($SnCl_2 \cdot 2H_2O$) and ascorbic acid. After washing with physiologic saline, labeled platelets were infused into human subjects. Platelet survival and turnover and body surface counting were done. Organ distribution of ^{99m}Tc-labeled platelets was observed by scintillation camera. Technetium-99m fulfilled all requirements of an ideal cell label. Platelets can be labeled for a brief period of time and there is no evidence that the label damages the platelets or is eluted from platelets under the conditions of the present study. In 13 out of 16 patients, sequestration observed by body surface counting coincided with sites of sequestration observed using a scintillation camera. In three cases in which platelet destruction rather than sequestration was present, the results using both techniques were different. It appeared that camera images obtained with ^{99m}Tc-labeled platelets would improve the limited collimation of a small part of the organ obtained by body surface counting and make possible quantitative measurement of the sites of platelet sequestration. (auth)

27309 RAPID RELIABLE METHOD OF LABELING Sn-MAA WITH $^{113m}InCl_3$. Allen, D. R.; Hartnett, D. E.; Nelp, W. P.; Hamilton, G. W. (Univ. of Washington, Seattle). J. Nucl. Med.; 15: No. 9, 821-822(Sep 1974).

A rapid method of labeling ^{113m}In to preprepared SN-MAA for myocardial perfusion imaging is presented. This material has proved safe for use in both animals and humans. The advantages of this method are that the Sn-MAA particles can be prepared in advance allowing for rigorous quality-control testing and the subsequent labeling procedure is simple and rapid. (auth)

27310 RADIONUCLIDE ANGIOGRAPHY IN THE DIAGNOSIS OF CAROTID CAVERNOUS SINUS FISTULA. Tully, T. E.; Shafer, R. B.; Reinke, D. B.; Pliego, M. P. (Univ. of Minnesota, Minneapolis). J. Nucl. Med.; 15: No. 9, 797-800(Sep 1974).

Radionuclide cerebral angiography using ^{99m}Tc-pertechnetate as tracer can be used to diagnose accurately carotid cavernous fistula. The use of this procedure in the evaluation of treatment of carotid cavernous fistula is stressed. The differential diagnosis of pulsating exophthalmos, cavernous sinus thrombosis, retro-orbital tumor, arterial or venous aneurysms, and arteriovenous malformations is discussed. (auth)

27311 ^{169}Yb-DTPA DISTRIBUTION AND DOSIMETRY IN CISTERNOGRAPHY. Morin, R. L.; Brookeman, V. A. (Veterans Administration Hospital, Gainesville, FL). J. Nucl. Med.; 15: No. 9, 786-796(Sep 1974).

Following intrathecal administration of 1 mCi ^{169}Yb-DTPA to nine patients, spinal counts were obtained from 2 to 48 hr with a gamma camera/computer system. Utilizing computer outputs, the length of the spine was divided into six equal segments approximately 2-in wide. The counts in each segment at each time were corrected for the surrounding blood background and converted to the percent of administered activity by reference to a standard. The cumulated activity in each segment was determined by graphic integration of mean activity–time curves. Absorbed radiation doses were computed for cylindrical geometry utilizing appropriate reduction coefficients for the dose contribution from electrons. Maximum doses to the surfaces of the cord and nerve roots are 31 ± 18 and 46 ± 20 rads, respectively, for 1 mCi ^{169}Yb-DTPA administered. By a depth of 0.01 cm, the thickness of the pia, these doses decrease to the average values of 5 ± 3 and 8 ± 3 rads, respectively. Surface and average doses to the cord and nerve roots from intrathecal administration of 400 μCi ^{169}Yb-DTPA are about the same as those from 100 μCi ^{131}I-IHSA. (auth)

27312 NECESSITY OF OBLIQUE VIEWS IN EVALUATING THE FUNCTIONAL STATUS OF A THYROID NODULE. Karelitz, J. R.; Richards, J. B. (Saint John's Hospital, Santa Monica, CA). J. Nucl. Med.; 15: No. 9, 782(Sep 1974).

A study was undertaken to determine the value of oblique gamma camera views in assessing the true functional status of thyroid nodules, which appeared nondelineated or hypofunctioning on the conventional anterior scintiscan. Fifty-five patients with a single palpable thyroid nodule were imaged with the scintillation camera fitted with a pinhole collimator, 6 hr following the oral administration of 100 μCi of ^{123}I-sodium iodide. Eighty-three percent of hypofunctioning nodules and 25% of nondelineated nodules were actually nonfunctioning when further evaluated with oblique views. Multiple views obtained with the scintillation camera and pinhole collimator provide a dramatically improved means of assessing the true relative function of a thyroid nodule. (auth)

27313 REGIONAL INTRARENAL PERFUSION IN MAN: AN ASSESSMENT WITH THE SCINTILLATION CAMERA. Kinoshita, M.; Holman, B. L.; Zimmerman, R. E.; Adams, D. F.; Adelstein, S. J.; Hollenberg, N. K. (Harvard Medical School, Boston). J. Nucl. Med.; 15: No. 9, 775-781(Sep 1974).

The importance of intrarenal perfusion patterns in a number of physiologic and pathophysiologic states has led to increasing interest in ^{133}Xe for assessing this parameter in man. In this study the scintillation camera has been used to evaluate concentric and segmental xenon turnover in normal man and in patients with hypertension and acute oliguric renal failure. In healthy kidneys the area of the image defined by the isotope decreased approximately 20% in the first minute after injection, a finding compatible with a cortical flow rate greater than that in the remainder of the kidney. Intrarenal blood flow rates defined with the camera were identical to those measured with a probe-mounted detector; however, recirculation did contribute to probe-recorded tail com-

ponents. In patients with oliguric renal failure, the study confirmed the absence of a rapid flow component. Failure of the size of the renal image to decrease, as it does normally, strongly supports the hypothesis of a preferential reduction in cortical perfusion. Washout of isotope from the superior and inferior renal poles was relatively homogeneous in normal man; however, there were quantitatively significant differences in segmental washout in patients with nephrosclerosis or chronic pyelonephritis. These studies provide strong support for current concepts of normal renal perfusion in which the rapid component of xenon washout represents cortical perfusion; they also confirm a model of acute renal failure in which there is a preferential reduction in cortical perfusion; and they suggest the presence of segmental renal perfusion abnormalities in patients with essential hypertension. (auth)

27314 QUICK METHOD FOR CALCULATION OF THE VASCULAR MEAN TRANSIT TIME. Phelps, M. E.; Eichling, J. O. (Washington Univ., St. Louis). J. Nucl. Med.; 15: No. 9, 814-817(Sep 1974).

A simple, quick, and accurate method is described for the determination of mean transit time from an arterial bolus injection of a radioactive nondiffusible tracer. Results using ^{15}O-labeled CO–hemoglobin as a tracer for the determination of the cerebral mean vascular transit time are included. (CH)

27315 RENAL CORTICAL IMAGING IN 35 PATIENTS: SUPERIOR QUALITY WITH ^{99m}Tc-DMSA. Enlander, D.; Weber, P. M.; dos Remedios, L. V. (Kaiser-Permanente Medical Center, Oakland, CA). J. Nucl. Med.; 15: No. 9, 743-749(Sep 1974).

The metal chelate 2,3-dimercaptosuccinic acid (DMSA) complexed with ^{99m}Tc appears to be a superior and safe renal scintigraphic agent, regularly revealing corticomedullary morphology with either a multihole or a pinhole collimator. Fifty percent or more of administered dose is retained by the renal cortex at 1 hr, the highest proportion that has been reported for any ^{99m}Tc complex. Scintiphotos of a variety of renal diseases and preliminary kinetic data are presented. (auth)

27316 RADIOIMMUNOASSAY OF PARATHYROID HORMONE: PERIPHERAL PLASMA IMMUNOREACTIVE PARATHYROID HORMONE RESPONSE TO ETHYLENEDIAMINETETRAACETATE. Chen, I. W.; Park, H. M.; King, L. R.; Bahr, G. K.; Goldsmith, R. E. (Univ. of Cincinnati). J. Nucl. Med.; 15: No. 9, 763-769(Sep 1974).

Plasma immunoreactive parathyroid hormone (IPTH) concentration was measured by radioimmunoassay according to the modified procedures of Arnaud and coworkers. Thirteen healthy control subjects and 20 patients with operatively proved primary hyperparathyroidism were studied. Each was given an infusion of ethylenediaminetetraacetate (EDTA) to produce a standard hypocalcemic insult. The parameters examined were the basal IPTH value, the peak post-EDTA IPTH value, the difference between these two values (absolute rise), and the ratio of these two values (EDTA-Index). All parameters were found to be significantly different between control and disease groups. Eleven of these 16 were studied postoperatively. In the nine thought to be cured, the post-operative EDTA studies revealed significant change toward normality. It is concluded that parathyroid tissue in patients with primary hyperparathyroidism is under at least positive feedback control; the hyperfunctioning parathyroid tissue in primary hyperparathyroidism patients is the hyperresponsive tissue; and using our antiserum, the parameters derived from the EDTA study have served to separate normal subjects from patients with primary hyperparathyroidism better than the basal plasma IPTH concentration alone. (auth)

27317 THYROTROPIN-RELEASING HORMONE (TRH): DISTRIBUTION IN HYPOTHALAMIC AND EXTRAHYPOTHALAMIC BRAIN TISSUES OF MAMMALIAN AND SUBMAMMALIAN CHORDATES. Jackson, I. M. D.; Reichlin, S. (Tufts New England Medical Center, Boston). Endocrinology; 96: No. 3, 854-862(Sep 1974).

A sensitive and specific radioimmunoassay for TRH is reported. Antibody was raised in a New Zealand white rabbit by immunization with TRH complexed to bovine thyroglobulin through bis-diazotized benzidine. The assay was capable of detecting below 7 pg of TRH in biological materials. Immunoreactive TRH was found in hypothalamic extracts from man, pig, rat, hamster, chicken, frog, snake, salmon, and in whole brain of the larval form of the primitive cyclostome lamprey, and in the head region of the protochordate amphioxus. The TRH levels in the frog hypothalamus were 1520–3620 pg/mg tissue, being 6–12 times the concentration detected in the rat hypothalamus. These findings indicate that TRH is distributed throughout the vertebrate kingdom, and has an ancient lineage. Immunoreactive (IR) TRH up to 764 pg/mg tissue was found in brain regions, other than hypothalamus, of the lower vertebrates, snake, frog, tadpole and salmon. Small but significant concentrations were also found in extrahypothalamic brain of the chicken and rat, the olfactory lobes containing mean levels of 17 and 6 pg/mg tissue, respectively. In all these species the highest brain concentrations occur in the hypothalamus and/or pituitary complex, though quantitatively in the lower species much more TRH lies outside that area; even in the rat, the total quantity outside the hypothalamus is close to that found in the whole hypothalamus itself. The identity of the IR-TRH measured was shown by the ability of extrahypothalamic frog brain extracts to release TSH from the rat pituitary in vivo. These findings suggest an extrathyroidal brain function for this tripeptide, possibly as a central neurotransmitter. (auth)

27318 LYMPHOCYTOTOXICITY ASSAY NOT REQUIRING THE IN VITRO CULTURE OF TARGET TUMOR CELLS. Kreider, J. W.; Flickinger, J. T.; Lengle, N.; Shoff, W. (Pennsylvania State Univ., Hershey). Transplantation; 18: No. 3, 223-228(Sep 1974).

A method is described that permitted the assessment of allogeneic cell-mediated immunity to tumor biopsies without an intervening period of tissue culture. Freshly excised tumor fragments were dissociated and labeled with $^{125}IUdR$. Sensitized or nonsensitized lymphocytes were mixed with tumor cells at an optimal ratio of 100:1. The mixed cell suspension was placed in diffusion chambers and inserted into the peritoneum of mice. Radioactivity was lost from the chambers only as a consequence of cell death. Approximately 5 days were required for demonstration of maximal lymphocytotoxicity. However, labeled target cells killed with heat lost all radioactivity within 24 hr. There was no detectable reutilization of label by adjacent living tumor cells. Target cells obtained directly from tumors were more easily killed by sensitized lymphocytes than target cells obtained from tissue cultures. The use of hosts allogeneic to both tumor cells and attacking lymphocytes did not interfere with the assay. These observations suggest the feasibility of this method for the assessment of tumor-specific immunity to human tumors. This approach should be especially useful in the study of immunity to human carcinomas, which oftern resist successful establishment in cell cultures. (auth)

27319 MEASUREMENT OF EARLY CHORIONIC ACTIVITY WITH A RADIOIMMUNOASSAY SPECIFIC FOR HUMAN CHORIONIC GONADOTROPIN FOLLOWING SPONTANEOUS AND INDUCED OVULATION. Kosasa, T. S.; Linda, C. M.; Levesque, A.; Taymor, M. L.; Goldstein, D. P. (Peter Brent Brigham Hospital, Boston). Fert. Steril.; 25: No. 3, 211-216(Mar 1974).

Serum HCG was measured by a radioimmunoassay specific for the beta subunit of HCG in nine patients who conceived after either spontaneous or induced ovulation. Two patients conceived following donor insemination and spontaneous ovulation. One patient conceived after ovulation induced by clomiphene citrate, and six patients conceived after HMG/HCG therapy. Serum HCG was first detected 8 and 11 days after presumed ovulation in the two patients who conceived following spontaneous ovulation and donor insemination. Serum HCG was measured 9 days after presumed ovulation in one patient treated with clomiphene citrate, and 10 to 15 days after presumed ovulation in six patients receiving HMG/HCG therapy. The doubling times of HCG were measured from 40 mIU/ml to 80 mIU/ml. Following spontaneous ovulation, the doubling times were 1.8 and 1.7 days, while the doubling times following induced ovulation ranged from 1.4 to 2.1 days. There appeared to be no significant difference between the initial time of detection of HCG after spontaneous or induced ovulation. There also appeared to be no appreciable difference in the pattern of rising serum HCG levels following spontaneous or induced ovulation. (auth)

27320 APPEARANCE OF ^{14}CO IN EXPIRED AIR AND INCORPORATION OF ^{14}C IN HEMOGLOBIN AFTER ADMINISTRATION OF GLYCINE-2-^{14}C IN MAN. Lindahl, J. (Karolinska Sjukhuset, Stockholm). Scand. J. Clin. Lab. Invest.; 33: No. 4, 353-359(Jun 1974).

The ^{14}C activity in exhaled carbon monoxide (CO) and in circulating hemoglobin heme was determined in ten healthy men, aged 43 to 60 years, following the administration of glycine-2-[^{14}C]. The early and the late peak in excretion of labeled CO was followed, as well as the appearance and elimination of labeled red cells in peripheral blood. Administration of the same total dose of labeled glycine in fractions for two or more days changed the pattern of [^{14}C]O excretion, but no significant difference in maximum specific activity of circulating hemoglobin heme was observed. A method for the quantitative trapping of CO from voluminous gas samples is presented. The methods for determination of ^{14}C activity in

exhaled CO and in circulating hemoglobin heme make it possible to carry out selective measurements in man of the turnover of heme compounds in the liver and the bone marrow and to follow a cohort of red cells during different physiological and pathophysiological conditions. (auth)

27321 APPLICATION OF RADIOISOTOPES. Radiocardiogram. Hirakawa, A.; Saito, M.; Motohara, S. (Kyoto Univ.). Nippon Rinsho; 32: No. 2, 315-325(Feb 1974). (In Japanese).

The use of the radiocardiogram for determining the volume of blood in the heart and circulation through the heart is described. The detection of radioactivity using a NaI crystal and collimation is discussed and methods for calculating cardiac output and circulation time using ^{131}I-labeled-serum albumin are described. The radiocardiogram in various heart diseases is discussed. (HLW)

27322 FACTORS INFLUENCING THE ^{51}Cr-LABELLING OF ERYTHROCYTES. Evaluation of the Signette Method. Seifert, J.; Messmer, K. (Univ., Munich). Eur. Surg. Res.; 2: 321-332 (1970).

From 4th Congress of the European Society for Experimental Surgery; Davos, Switzerland (Apr 1969).

The reliability of Kuni's method for rapidly tagging erythrocytes with ^{51}Cr by the use of ion exchangers was tested using different parameters. The content of free ^{51}Cr in serum of labelled blood was measured in order to find the factors influencing directly the labelling of the erythrocytes and indirectly the blood volume determination. Change of the chromium doses, storage time of the ion exchanger, the solvent of $Na_2{}^{51}CrO_4$ and hemolysis did not increase the content of free ^{51}Cr in serum; but the choice of the anticoagulant, serum protein content, hematocrit and blood pH as well as the presence of reducing substances are of essential importance using Kuni's method. It is proved that the increased ^{51}Cr content in serum is caused by trivalent ^{51}Cr, which cannot be bound by erythrocytes or serum proteins. Blood volume measurements in dogs showed that the content of free ^{51}Cr in serum corresponds well with the error in blood volumetry. As a twofold passage through ion exchangers remains without any effect on a high content of free ^{51}Cr in serum it is suggested to wash erythrocytes after labelling in order to obtain reliable blood volume data. (auth)

27323 CADMIUM AVAILABILITY TO WHEAT: A STUDY WITH RADIOACTIVE TRACERS UNDER FIELD CONDITIONS. Stenstroem, T.; Loensjoe, H. Ambio; 3: No. 2, 87-90(1974).

A micro-plot method useful for studies of long-term variations in cadmium availability and the effect of cultivation practices such as fertilization and liming is presented. The uptake of cadmium from soils and different applications of sewage sludge was determined independently by use of sludge labelled with ^{109}Cd or ^{115m}Cd and by atomic absorption analysis of total cadmium. It is indicated that even a limited use of sludge eventually may give concentrations of cadmium in agricultural products that are intolerable with regard to the WHO recommendations for human intake of cadmium. (auth)

27324 ^{14}C-NICOTINE DISTRIBUTION AND MOVEMENTS IN SLICES FROM MONKEY CEREBRAL CORTEX. Aldrice, M. T.; Weiss, G. B. (Univ. of Texas, Austin). Arch. Int. Pharmacodyn.; 209: 162-171(1974).

The uptake of ^{14}C-nicotine in capuchin monkey cerebral cortex slices was measured at several pH levels. At both 37 and 0°C, the 45-min ^{14}C-nicotine tissue spaces were increased as the extracellular pH was raised; at all pH levels the uptake of ^{14}C-nicotine at 0°C was significantly lower than at 37°C. At pH 7.20 and 0°C, the 90-min ^{14}C-nicotine space eventually approached the same level as the 45-min one at 37°C, whereas the ^{14}C-nicotine space value at pH 8.20 and 0°C remained markedly lower than that at pH 8.20 and 37°C. Efflux experiments demonstrated that at 37°C (but not 0°C) the additional quantity of ^{14}C-nicotine accumulated at pH 8.20 is present in the slower washout component. Only a small amount of ^{14}C-nicotine appeared to be membrane-bound. Thus, a temperature-dependent increase in ^{14}C-nicotine efflux could be demonstrated, and this accumulation of ^{14}C-nicotine at pH 8.20 and 37°C cannot be explained solely by a passive equilibration process. (auth)

27325 COMPARISON OF ^{133}Xe REGIONAL STUDIES DURING SPONTANEOUS BREATHING AND BRONCHOSPIROMETRY. Peset, R.; Gimeno, F.; van Haeringen, J. R.; Beekhuis, H.; Woldring, M. G. Scand. J. Resp. Dis.; 55: 91-98(1974).

The diagnostic results obtained with ^{133}Xe regional scintigraphic studies of the respiratory tract with a spontaneous breathing technique are compared with those obtained with bronchospirometry, for ventilation, perfusion, and volume. When the ^{133}Xe ventilation wash-in curves were analyzed in terms of the exponential function it was possible to calculate regional alveolar ventilation and alveolar volume in absolute values or as percentages of the total. The percentage values are compared with the bronchospirometry values. Perfusion was calculated as percentage of the total. The correlation between bronchospirometry and ^{133}Xe was very good judging from the correlation coefficients found, although the slope of the regression differs from the identity line. Factors affecting the results are discussed. (auth)

27326 METHODOLOGICAL PROBLEMS AND CLINICAL VALIDITY OF AN ACTH RADIOIMMUNOASSAY METHOD APPLIED TO EXTRACTED PLASMA SAMPLES. Genazzani, A. R.; Fraioli, F.; Conti, C.; Fioretti, P. (Cagliari Univ., Italy). J. Nucl. Biol. Med.; 18: No. 2, 67-79(1974).

A suitable and relatively simple method for ACTH radioimmunoassay is described in the assay sequence. A preliminary extraction of the hormone from plasma is included in the assay sequence. The validity of the method for research and clinical application has been checked by evaluating the specificity, sensitivity, and precision of the measurement. The validity of the ACTH measurement as compared to the indirect evaluation by plasma cortisol assay is discussed. The method has also made possible to detect in plasma of pregnant subjects the presence of a protein from placental origin cross-reacting with synthetic ACTH, which has been named Human Chorionic Corticotrophin (HCC). (auth)

27327 ENDOCRINOLOGICAL MONITORING OF LATE PREGNANCY: HCS PLASMA LEVELS AND CHRONIC FETAL DISTRESS. Genazzani, A. R.; Cocola, F.; Nasi, A.; Neri, P.; Fioretti, P. (Cagliari Univ., Italy). J. Nucl. Biol. Med.; 18: No. 2, 60-66(1974).

On the basis of previously published papers on the correlation between HCS plasma levels and placental function, the authors have investigated the behavior of HCS plasma levels in cases of chronic fetal distress. The cases of chronic fetal distress were subdivided into different groups according to the maternal or placental pathology: apparently normal pregnancy, pre-eclampsia, severe eclampsia, feto-placental dystrophy, multiple placental infarcts, and prolonged pregnancy. In all cases followed for a period of time the HCS pattern indicated the pathological condition of the conceptus 2 to 5 weeks before the onset of labor. In cases examined only once, such as prolonged pregnancy, the HCS levels were always significantly lower than normal. These results confirm the importance of the application of HCS radioimmunoassay to diagnose the presence of chronic fetal distress. (auth)

27328 CAMERA-KINEMATOGRAPHY: A NUCLEAR MEDICINE PROCEDURE FOR IMAGING HEART KINETICS. Adam, W. E.; Meyer, G.; Bitter, F.; Kampmann, H.; Stauch, M.; Pavia, M. (Univ. Ulm, Donau, Ger.). J. Nucl. Biol. Med.; 18: No. 2, 53-59(1974).

Camera kinematography makes it possible to observe heart kinetics in steady state after homogeneous distribution of 10 mCi ^{99m}Tc-human serum albumin in the blood pool. An R-wave gated time averaging procedure allows the acquisition of adequate data to overcome background problems. Blood pool fluctuations during one heart cycle can be reliably presented within areas nearly as the resolution power of the camera. The procedure allows the presentation of radioactivity profiles of rows and columns of the heart matrix and their variations during one heart cycle. The rapid sequential display of those profiles yields an impression of the kinetics of that part of the heart. The quantitative evaluation of systolic-diastolic differences of the count rate in order to obtain data concerning ejection fraction and rest volume of both ventricles has to face some problems in the moment, especially extracardial contributions to the count rate, which likely could be overcome by some subtraction procedures. Further problems, especially geometrical conditions of the measurement, are discussed. (auth)

27329 CAMERA RADIOCARDIOGRAPHY BASED ON THE FIRST TRANSIT PRINCIPLE. Adam, W. E.; Meyer, G.; Bitter, F.; Kampmann, H.; Stauch, M. (Univ. Ulm, Donau, Ger.). J. Nucl. Biol. Med.; 18: No. 2, 44-52(1974).

The estimation of the ejection fraction of both ventricles, using camera radiocardiography based on the first transit principle failed for both fundamental and methodological reasons. Radiocardiography in the steady state seems to offer a better approach to this problem. (auth)

27330 ABNORMAL LIVER SCANS IN PATIENTS WITH α_1-ANTITRYPSIN DEFICIENCY. Yun Ryo, U.; Moses, D. C.; Milam, W. F. (Univ. of Michigan, Ann Arbor). J. Nucl. Biol. Med.; 18: No. 2, 39-43(1974).

Abnormal liver and spleen scans were obtained in two adult patients with heterozygous α_1-antitrypsin deficiency. The liver biopsy performed on one patient demonstrated the morphologic and histochemical changes which are characteristic of α_1-anti-

trypsin deficiency. These cases illustrated a possible role for liver scanning in screening and following α_1-antitrypsin deficiency of liver disease. (auth)

27331 INSULIN RADIOIMMUNOASSAY: A COMPARISON OF THREE METHODS. Malvano, R.; Zucchelli, G. C.; Quesada, T.; Gandolfi, C.; Piro, M. A. (National Research Council, Pisa, Italy). J. Nucl. Biol. Med.; 18: No. 2, 80-86(1974).

The separation methods using adsorbents (dextran-coated charcoal and anionic resin) to sequestrate the unbound radioactivity and the immunoprecipitation variant employing preincubated insulin antiserum and precipitating antiserum, were compared as far as their accuracy, sensitivity, precision, and practicability are concerned. The adsorbent methods were found to yield substantially identical analytical results (e.g. fasting plasma: 9.4 ± 3.6 and 8.7 ± 3.1 μU/ml for charcoal and resin method, respectively), while significantly higher data were obtained with the double-antibody technique (e.g. fasting plasma: 16.2 ± 4.5 μU/ml). In particular, the lower accuracy of the latter method is suggested by the measurement of significant levels of insulin (5.5 ± 2.5 μU/ml) in insulin-deprived samples. Sensitivity and precision levels compatible with the requirements for routine measurements were obtained in all cases, but in the author hands the resin method was found less practicable. (auth)

27332 STAPHYLOCOCCAL RADIOIMMUNOASSAY FOR HEPATITIS B ANTIGEN AND ANTIBODY. Figenschau, K. J.; Ulstrup, J. C. (Ullevaal Sykehus, Oslo). Acta Pathol. Microbiol. Scand., Sect. B; 82: 422-428(1974).

A rapid radioimmunoassay (RIA) for the measurement of hepatitis B antigen and antibody is described in which protein A carrying Staphylococcus aureus is used as a solid phase anti-gamma globulin reagent. The tests are easy to perform, they are completed in two hours, and are easily automatized. The competition principle is used for antigen testing while antibody is measured by direct binding of radiolabelled hepatitis B antigen. Using human reconvalescent antisera, the staphylococcal test for antigen in 25 μl serum has about the same sensitivity as the Ausria test. The staphylococcal test for antibody has at least the sensitivity of the passive hemagglutination test. Both tests are highly specific. (auth)

27333 COST REDUCTIVE METHOD FOR THE RADIOIMMUNOASSAY OF PLASMA ANDROSTENEDIONE. A Comparison of Antisera and the Effects of Chromatography. Hennam, J. F.; Collins, W. P. (King's Coll., London). Acta Endocrinol.; 76: 597-607(1974).

A method is described and evaluated for the determination of androstenedione (A) in peripheral venous plasma. The potential use of antisera to A-6-carboxymethyl thioether-bovine serum albumin and A-11α-succinyl-bovine serum albumin has been evaluated. The same plasma samples have been analyzed before and after chromatography on a micro column of Sephadex LH-20. A dye, azobenzene is used to locate the fraction containing androstenedione. The results show that there is no significant difference in the values of apparent A using either antisera (overall mean 3.2 ng/ml plasma from men and 2.8 ng/ml from women). After chromatography these values are reduced by 62 and 42% respectively to 1.2 and 1.6 ng/100 ml. A new method using a mixture of ammonium and calcium sulphates is described for the separation of steroid bound to antibody. The precipitate is then resuspended and the amount of radioactivity determined, directly in the assay tube, by liquid scintillation counting. This process effects a 68% reduction in the cost of the assay of each plasma sample. (auth)

27334 PHOSPHOLIPID SYNTHESIS BY THE MONKEY FETUS. Reynolds, W. A.; Pitkin, R. M.; Filer, L. J. Jr. (Univ. of Illinois, Chicago). pp 368-375 of Medical Primatology 1972. Part III. Goldsmith, E. I. (ed.). Basel; S. Karger AG (1972).

From third conference on experimental medicine and surgery in primates; Lyon, France (Jun 1972). See CONF-7206103-P3.

The biosynthesis of two phospholipids, lecithin and spinogomyelin, in serous membranes of fetal monkeys (Macaca mulatta and Macaca speciosa) was measured as an indication of maturation of the lungs, using ^{14}C-choline and ^{32}P-phosphate as tracers injected into the maternal circulation. Samples of placental tissues, fetal liver, trachea, brain, muscles, and lung, amniotic fluid, and fetal and maternal blood obtained at various intervals during gestation were assayed for radioactivity by a double-label counting technique. No obvious differences were found in the rate of incorporation of the isotopes in lecithin and spinogomyelin in relation to fetal age. (CH)

27335 STUDIES ON THE REACTION OF β-LACTOGLOBULIN AND α-LACTALBUMIN DURING HEAT TREATMENT OF MILK BY MEANS OF ^{131}I-LABELLED WHEY PROTEINS. Wiechen, A.; Knoop, A. M. (Bundesanstalt fuer Milchforschung, Kiel (F.R. Germany). Inst. fuer Physik). Milchwissenschaft; 29: No. 2, 65-70(Feb 1974). (In German).

8 figs.; 16 refs. With abstract in German and English.

In order to obtain information on the reaction of the two most frequent whey proteins, β-lactoglobulin and α-lactalbumin during heat treatment of milk, they were labelled with ^{131}I and heating experiments performed. The two serum proteins were shown not only to react with the kappa-casein on the surface of casein miscelles and thereby affecting the casein, but also to react between themselves and to compete with each other for reaction. Under practical conditions of pasteurization, the effects on casein are nearly exclusively due to the reaction between kappa-casein and β-lactoglobulin. The extent of the effect on casein is given by the incidental ratio of concentration of the two competing proteins. If the portion of β-lactoglobulin is increased, the heat effects on casein will be increased. On the other hand, it may be expected that the addition of a certain amount of α-lactalbumin may have a decreasing effect. (auth)

27336 A DOUBLE ISOTOPE TECHNIQUE FOR ESTIMATING INSULIN DEGRADATION IN VIVO. Ritzl, F.; Feinendegen, L. E.; Schnippering, H. G. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Medizin). Nucl.-Med.; 13: No. 1, 85-97(May 1974).

6 figs.; 2 tabs.; 24 refs.

A double isotope technique is described, which permits measuring by external counting the catabolism of insulin in the human liver. ^{131}I-insulin is used together with ^{51}Cr-insulin as internal standard. Following catabolism of the labeled insulins ^{131}I migrates into the iodine pool of the body whereas ^{51}Cr remains at the site of insulin breakdown. Therefore, site and rate of insulin catabolism can be recognized from the change in the isotopic ratio ^{131}I/^{51}Cr. In the livers of 3 normal individuals, insulin half-lives of 58, 95, and 92.5 minutes were measured. In 3 patients with subclinical diabetes mellitus, insulin half-lives were 124.5 minutes, 127 minutes, and 99.5 minutes. One patient with clinical diabetes showed an insulin half-life of only 47.8 minutes; a second patient with clinical diabetes mellitus due to autoimmune response leading to large amounts of insulin antibody in his peripheral blood, showed an insulin half-life greatly prolonged to 972 minutes. The ^{51}Cr-labeled insulin was indistinguishable from ^{125}I-labeled insulin in the immunoassay, in molecular size, in diffusion rate in tissues, absorption to subcellular particles, and rate of hydrolysis in liver homogenates in vitro. (auth)

MATERIALS

27337 ELASTIC SCATTERING OF SLOW NEUTRONS BY ANTIFERROMAGNETS WITH DOMAIN STRUCTURE. Bar'yakhtar, V. G.; Gorobets, Yu. I.; Sobolev, V. L. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 3, 458-463(Mar 1974). (In Russian).

The elastic scattering cross-section and polarization are calculated after dispersion of slow neutrons on antiferromagnets with a domain structure that is close to the point of first order phase transition. Transitions due to changes of the external magnetic field or of the temperature were examined. (tr-auth)

Ceramics and Cermets

Refer also to abstracts 26499, 26858, 27100, 27444, 27483, 27497, 28042, 28669, 28680, and 28801.

27338 (AD-773175) GRAVIMETRIC AND ELECTRICAL CONDUCTIVITY STUDIES OF PURE AND DOPED NIOBIUM PENTOXIDE. Final Report. Tripp, W. C.; Wimmer, J. M. (Systems Research Labs., Inc., Dayton, Ohio (USA)). Nov 1973. Contract AF33(657)-2765. 35p. (ARL-73-157). NTIS $3.25.

Thermogravimetric and electrical conductivity measurements on alpha Nb_2O_5 were made over the temperature range 900–1300°C in CO/CO_2 mixtures and in pure oxygen. Anomalous conductivity results to low P_{O_2} suggest the presence of nonstoichiometric phases. The data at higher P_{O_2} are analyzed on the basis of a defect model consisting of impurity control of the oxygen vacancy concentration at high P_{O_2} with a transition to a predominance of electrons and fully ionized oxygen vacancies at lower P_{O_2}. The mobility, obtained by combining gravimetric and conductivity data, is shown to have negative temperature dependence with a value of 0.15 $cm^2/V\text{-}s$ at 1000°C. A value of -175 kcal/mole is obtained for the partial molar enthalpy of oxygen in Nb_2O_{5-x} over the range of x from 0.0025 to 0.01. (GRA)

27339 (AD-774528) STUDY OF NUCLEATION AND DYNAMIC PHENOMENA OF THERMAL FILAMENTS IN VANADIUM DIOXIDE. Neal, W. H. II.; Walser, R. M.; Bene, R. W. (Texas Univ., Austin (USA). Electronics Research Center). 12 Sep 1973. Contract F44620-71-C-0091. 66p. (AFOSR-TR-74-0148). NTIS $3.75.

The switching event responsible for the breakdown of thin films of vanadium dioxide which leads to the production of thermal filaments was theoretically and experimentally studied. It was found that a critical-temperature mechanism associated with the vanadium dioxide transition temperature was responsible for the breakdown event. A scanning infrared microscope was used to examine the thermal filaments at various bias points and ambient temperatures. The filament width and peak temperature were found to be sensitive functions of these parameters. It was also found that thermal filaments could exist at temperatures very near ambient due to thermal hysteresis. (GRA)

27340 (AD-776414) METAL-GROWN OXIDE–METAL COMPOSITES. Final Technical Report, 10 June 1971–31 December 1973. Chapman, A. T.; Benzel, J. F.; Cochran, J. K.; Feeney, R. K.; Ling, F. W. (Georgia Inst. of Tech., Atlanta (USA)). Dec 1973. Contract DAAH01-71-C-1046. 235p. (E-18-604-6). NTIS $6.00.

The research program was designed to develop metal-grown oxide–metal composite structures for high field electron emission testing. A variety of refractory oxide–metal mixtures (i. e. UO_2–W, stabilized ZrO_2 and HfO_2–W, UO_2–Ta, and the rare earth oxides Gd_2O_3, Nd_2O_3 and La_2O_3–Mo and W) were successfully induction melted and unidirectionally solidified to form aligned metallic fibers embedded in the oxide matrix. Metal solubility in the molten oxides, control of the oxide stoichiometry, and metal volatility were shown to be significant parameters controlling the successful composite growth in these systems. Emission measurements were performed with a variety of unusual emitter geometries, including metallic coated samples and structures designed to operate at low voltages (<100 V). Analysis of post-emission damage and emission performance were used to assess the probable failure mechanism limiting the current density and life of the oxide–metal cathode structures. (GRA)

27341 (CONF-740724-1) HIGH TEMPERATURE PLASTICITY OF OXIDE NUCLEAR FUEL. Roberts, J. T. A. (Argonne National Lab., Ill. (USA)). 1974. 23p. Dep. NTIS $4.25.

From symposium on plastic deformation of ceramics; University Park, Pennsylvania, USA (Jul 1974).

Certain UO_2–20 wt % PuO_2 fuel materials fabricated at ANL have demonstrated the possibility of superplastic-like deformation at only 100°C above the brittle–ductile transition temperature. The enhanced ductility, which in one test reached 15% strain in bending, appeared to be facilitated by a grain-boundary impurity liquid phase in larger grain-size materials. (11 figures) (auth)

27342 (FEI-341) NEUTRON-DIFFRACTION STUDY OF THE STRUCTURE AND PROPERTIES OF TRANSITION METALS. Miron, N. F.; Shcherbak, V. I.; Bykov, V. N.; Ledvik, V. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1972. 22p. (In Russian). INIS.

The structures of simple ($ScH_{1.63}$, YD_3, $TiD_{0.6}$) and complex ($ZrC(N)_{0.3}H_{1.01}$, $(Zr_{0.34}Ti_{0.66})D_x$, $(Nb_{0.34}Ti_{0.66})D_x$, ZrV_2D_x) hydrides (deuterides) were studied by a neutronographic method. It was shown that in alloys of the transition metals the H is located at tetrahedral vacancies and in the YH_2 phases rich in hydrogen, at octahedral and trigonal vacancies of the metal matrix. In alloys with a bcc lattice, at low concentrations there is a proximate order in the distribution of the implanted atoms. With D/metal = 1, in alloys with a bcc lattice there is ordering of the implanted atoms. In ordered hydrides of the composition MeH (where Me = Nb + 66% Ti or Ta + 66% Ti), ordered–nonordered phase transition occurs at high temperatures. The presence of a second introduced element (C, N, O) decreases the solubility of the H in the metal and its thermostability. Correlation of structural peculiarities with physical properties of hydrides (equilibrium dissociation pressure) is discussed. The possibility of localization of hydrogen in different types of vacancies is considered from the viewpoint of the measured factor and the electron structure of the metal and hydrogen. (tr-auth)

27343 (IRS-SB-3) THERMAL CONDUCTIVITY AND EMISSION RATE OF SOLID UO_2. Literature Study. Neuer, G.; Brandt, R.; Haufler, G. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Aug 1973. 217p. (In German). INIS.

With figs., tab., and refs. with abstract.

A great number of studies on the thermal conductivity of solid UO_2 have been published within the last fifteen years. The great diversity of the results reported is partly due to the difference in composition and structure as a result of the production method and the thermal and mechanical treatment, as well as to the degree of burnup. Another reason lies in the different measuring methods applied, which may likewise lead to differing results for the thermal conductivity. Therefore, it has been thought appropriate and useful to make a literature study and to compile presently available data on the thermal conductivity, to review the various experiments with a view to finding experimental details common to all studies and to stating the dependence of the thermal conductivity on the several parameters in order to show the true reasons for the great difference in results. First, the general principles of the theory of thermal conductivity and different measuring methods are discussed as far as nuclear fuels, especially UO_2, are concerned and as far as necessary with regard to the problems to be examined. The study is based on earlier reviews of the thermal conductivity of UO_2, and part of the data given in these reviews has also been included in the study. There are only a few publications so far concerning the measurement of the emission rate of UO_2 as a surface property. Most of the material reviewed in the study deals with measurements for the purpose of gaining information about the inner radiative heat transfer contributing to the overall thermal conductivity. In the second part, results on the spectral emission rate and the total emission rate of UO_2 are given and discussed. Since the dependence of the emission rate on surface conditions cannot be seen from the measurements reported, the behavior of other oxides is given and discussed for comparative purposes. The spectral emission rate is of great importance for pyrometric temperature measurements and therefore is discussed. (auth)

27344 EFFECT OF MODE OF LOADING ON THE HIGH-TEMPERATURE CREEP OF ZIRCONIUM CARBIDE. Zubarev, P. V.; Dement'ev, L. N. Strength Mater. (USSR) (Engl. Transl.); 5: No. 8, 964-967(Aug 1973).

Translated from Probl. Prochnosti; 5: No. 8, 61-64(Aug 1973).

Results of investigations into the effect of the method of loading on the creep of fine-grain zirconium carbide showed that a single creep mechanism is observed for the different methods of loading. The difference in absolute rates of creep for tension, compression, and bending is small and lies within the limits of error of their measurement. Results of analysis of the experimental data for the high-temperature creep of zirconium carbide

indicate that there is a linear relationship between the rate of deformation and stress. The creep curves are characterized either by the absence of nonsteady-state stage or by a short continuance of the first section. It must be noted that the apparent activation energy of creep for fine-grain zirconium carbide is lower than the activation energy for the bulk self-diffusion of zirconium in ZrC and, within the limits of experimental error, approximates to the activation energy for boundary self-diffusion. Taking into account that high Peierls stresses exist in carbide materials it can be supposed that creep is brought about by a Nabarro–Herring mechanism. (auth)

27345 X-RAY PHOTOELECTRON SPECTROSCOPY OF SOME URANIUM OXIDE PHASES. Allen, G. C. (Central Electricity Generating Board, Berkeley, Eng.); Crofts, J. A.; Curtis, M. T.; Tucker, P. M.; Chadwick, D.; Hampson, P. J. J. Chem. Soc., Dalton Trans.; No. 12, 1296-1301(1974).

X-Ray photoelectron spectra of a variety of uranium oxides were studied and compared with the spectrum obtained from the pure metal. The oxide phases studied were $UO_{2.0}$, $UO_{2.1}$, $UO_{2.2}$, U_4O_9, U_3O_7, U_3O_8, and γ-UO_3 where the formal oxidation number of uranium alters from IV to VI. Significant chemical shifts observed for U 4f and O 1s peaks are explained by consideration of chemical structure and changes in uranium and oxygen oxidation states. The surface oxidation of uranium dioxide powder in air was studied by comparing the spectra with those of UO_2 pellets and higher uranium oxides. (auth)

27346 INTERATOMIC INTERACTION IN THE REGION OF HOMOGENEITY OF TITANIUM AND VANADIUM MONOXIDES. Aivazov, M. I.; Muranevich, A. Kh. (Inst. of New Chemical Problems, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 12, 1903-1905(Dec 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 12, 2156-2158(Dec 1973).

The ir absorption spectra of the variable-composition oxides $TiO_{1\pm x}$ and $VO_{1\pm x}$ were investigated. The steady position of the M–O valence-vibration band in these oxides gives grounds for assuming that the bond rigidities are practically the same. The fact that the intensity of the vibrational bands of $TiO_{1\pm x}$ decreases with increasing value of x more rapidly than in the case of $VO_{1\pm x}$ is due to the lower degree of polarity of the M–O bond in $TiO_{1\pm x}$. Owing to the fact that overlapping of the dε orbits of the metal in $VO_{1\pm x}$ is less than in $TiO_{1\pm x}$, despite the greater number of valence electrons the values of the electronic component of the thermal conductivity are similar. It is assumed that in $VO_{1\pm x}$ specimens with an excess of oxygen an increase in the degree of ionicity of the M–O bond somewhat reduces the lattice component of the thermal conductivity. (auth)

27347 ISOTHERMAL CROSS SECTIONS OF THE SYSTEM Co, Ni–Al, Si–B. Chaban, N. F.; Kuz'ma, Yu. B. (Lvov State Univ., USSR). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 12, 1886-1889(Dec 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 12, 2136-2140(Dec 1973).

Using x-ray structural analysis and to a lesser extent microstructural analysis, the systems Co, Ni–Al, Si–B were investigated and isothermal cross sections (800 and 1000°C) constructed. The existence of new ternary borides ~$Co_3Al_2B_5$, ~$Ni_5Al_2B_4$, β- and α-Ni_9AlB_{11} (the polymorphic transition temperature is 800-1000°C). The compound β-Ni_9AlB_{11} has a monoclinic structure of a new type (a = 35.8, b = 10.93, c = 16.3 Å, β = 112°). (auth)

27348 HOW THE DEFECT CONTENT OF THE CARBON SUBLATTICE INFLUENCES THE PROPERTIES OF REFRACTORY TRANSITION-METAL CARBIDES. Samsonov, G. V. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 12, 1893-1898(Dec 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 12, 2144-2150(Dec 1973).

The variation of the physical and physicotechnical properties of monocarbides of the Group IV and V transition metals in their regions of homogeneity was studied and an interpretation offered, based on the hypothesis that the degree of localization of the valence electrons on M–M bonds increases and that on M–C bonds decreases as carbon atoms are subtracted within the region of homogeneity. It is shown that the properties of vanadium carbide have a dual nature: some of them vary like those of carbides of Group IV metals, while others vary like those of the carbides of niobium and tantalum, owing to the degree of localization of valence electrons on vanadium atoms, which is close to the limiting value of the degree of localization which separates regions of more and less perfect electron and crystal structures. (auth)

27349 SUBSTRUCTURE AND DISINTEGRATION PATTERN OF SINGLE CRYSTALS OF ZIRCONIUM AND NIOBIUM CARBIDES. Funke, V. F.; Pshenichnyl, I. V.; Kruglov, V. N.; Kharkhardin, E. D. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 12, 1899-1902(Dec 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 12, 2151-2155.

The substructure of single crystals of the carbides $ZrC_{0.96}$ and $NbC_{0.975}$ was investigated by means of selective etching and diffraction micro-x-ray analysis. The brittleness of the carbides decreases as one goes from the (100) plane to the (110) plane and thence to the (111) plane, and also as one goes from $ZrC_{0.96}$ to $NbC_{0.975}$. (auth)

27350 THERMODYNAMICS OF LaB_6 FORMATION BY THE BOROTHERMAL REACTION. Meerson, G. A.; Nurmukhamedov, V. Kh.; Manelis, R. M. (Moscow Inst. of Steel and Alloys). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 12, 1884-1885(Dec 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 12, 2133-2135(Dec 1973).

An equation was derived for the temperature dependence of the Gibbs free energy of the formation of LaB_6 by boron reduction of La_2O_3. The theoretical data obtained from this equation are confirmed by the experimental data. It is shown that the onset temperature of reaction is reduced when it takes place in vacuum. (auth)

27351 ELECTROMAGNETIC PROPERTIES OF METALLIKE COMPOUNDS FROM THE VIEWPOINT OF ZONE THEORY. Bukatov, V. G.; Solov'ev, G. S.; Travushkin, G. G.; Rymashevskii, G. A.; Umanskii, Ya. S. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 12, 1879-1883(Dec 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 12, 2127-2132(Dec 1973).

The electromagnetic properties of nonstoichiometric carbides and nitrides of transition metals of Groups IV and V of their solid solutions are discussed. There is a correlation between the variation of the properties and the valence-electron concentrations and electron energy spectrum. The electrical resistance is maximal for the compounds $M^{IV}C_{1.0}$, $M^{V}C_{0.75}$, $M^{IV}N_{0.8}$ with eight valence electrons per metal site. (auth)

27352 OBSERVATION OF POINT DEFECTS IN NIOBIUM OXIDES BY HIGH RESOLUTION EM. Iijima, S. (Arizona State Univ., Tempe). pp 232-233 of Proceedings of the Thirty-first Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (Ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

Structural information on Nb oxides at electron microscopic resolutions in the range 3 to 5 Å are described. Discussions and images of reduced $Nb_{22}O_{54}$ are included along with a proposed model of a point defect in $Nb_{12}O_{29}$. (JRD)

27353 INFLUENCE OF Al_2O_3 ON THE SINTERING AND PROPERTIES OF YTTRIUM OXIDE CERAMICS. Borovkova, L. B.; Korovina, A. K.; Lukin, E. S.; Poluboyarinov, D. N. (Inst. of Chemical Tech., Moscow). Refractories (USSR) (Engl. Transl.); 14: No. 9-10, 615-620(1973).

Translated from Ogneupory; 14: No. 10, 17-24(Oct 1973).

The influence of Al_2O_3 added to yttrium oxide in proportions of 0.2 to 5 mole % on the sintering process was studied with a view to investigating the practicability of grinding Y_2O_3 with corundum balls. It was established that the additive has a favorable influence, the optimum proportion being 1 mole % Al_2O_3, as a result of the formation of a new phase which appears to be yttrium aluminate of the composition $2Y_2O_3 \cdot Al_2O_3$. It was demonstrated that grinding Y_2O_3 with corundum balls has technical advantage since in this case the specific molding pressure can be reduced from 2000 to 500–1000 kg/cm² and the firing temperature by 250–300°C. In regard to thermomechanical properties other than the temperature of deformation under a load of 2 kg/cm², the high-density Y_2O_3 ceramic is not inferior to Y_2O_3 ceramic without Al_2O_3 additive, and in regard to electrical resistance it is slightly superior. (auth)

27354 ELECTRIC KILN WITH ZIRCONIA HEATERS FOR OPERATION IN AIR AT 2000°C. Rutman, D. S.; Maurin, A. F.; Taksis, G. A.; Toropov, Yu. S. Refractories (USSR) (Engl. Transl.); 14: No. 9-10, 652-654(1973).

Translated from Ogneupory; 14: No. 10, 53-56(Oct 1973).

The design of a kiln for heat treating super-duty refractory materials is described. The lining is based on oxides of Zr, Hf, Mg, Ca, Y, Al, etc. The useful space in the kiln is about 1 dm³. The temperature variation does not exceed ±25°C at 2000°C. (DLC)

27355 ELECTRON PROPERTIES OF A RUBY IRRADIATED BY HIGH-ENERGY ELECTRONS. Akimovich, I. N.; Grishaev, I. A.; Sikora, A. V. (Inst. of Radiophysics and Electronics, Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 3, 402-405(Mar 1974). (In Russian).

The absorption and radiation of ruby irradiated by 10-MeV electrons from a linear electron accelerator were studied. The absorption spectrum of the irradiated ruby did not differ significantly from that of the nonirradiated, especially in the uv, where the absorption was high. The limit of the absorption of the irradiated crystals was shifted 40 to 50 nm toward the longer waves. The absorption spectrum of the irradiated material showed a series of additional bands due to F centers and to change in the valence of the Cr, O, and Al ions. Irradiation changed the luminescence of the ruby in the red region, with contraction of the bands and some decrease in the intensity. However, since the irradiated ruby begins to phosphoresce, the luminescence of the ruby actually increases after irradiation. (tr-auth)

27356 ANALOGIES AND DIFFERENCES BETWEEN COMPOUNDS OF Mo AND OTHER EARLY TRANSITION METALS (Ti, V, Nb, Ta, W). Guerchais, J. E. (Universite de Bretagne Occidentale, Brest, France). J. Less-Common Metals; 36: No. 1/2, 47-52(1974).

The existence of several isomers of the ions $(MoO_nF_m(AB))^-$ (n = 0, 1, 2, n + m = 4, AB = bidentate ligand; M = Mo, W, Ti, V). The trans position has also been observed in monomeric or dimeric compounds (e.g., $(Mo_2O_4F_4(C_2O_4))^{2-}$). Although previous workers have reported the reduction of molybdenum(VI) in HBr medium, by reducing the rate of the oxidation-reduction process, the co-existence of Br^- and Mo(VI) ions was observed here when preparing numerous compounds with a view to exchange. The natural preferential selection of structural forms is found through exchanging F, Cl, and Br. X-ray crystallographic measurements show the resemblance between the ligands O, F, Cl, O-O, which makes it possible to broaden the idea of oxo-species. These analogies are not apparent from spectroscopic methods. (auth)

27357 MoO_3-WO_3 AND $Li_2O-MoO_3-WO_3$ SYSTEMS. Gloeikler, D.; Jeannot, F.; Gleitzer, C. (CNRS, Nancy, France). J. Less-Common Metals; 36: No. 1/2, 41-45(1974).

The oxidation at moderate temperatures of solid solutions of the dioxides $(Mo,W)O_2$ permits a determination of the system MoO_3-WO_3. A monophasic region, $Mo_{1-x}W_xO_3$ ($0.35 < x < 0.85$), appears with two polymorphic modifications. In the system $LiO_2-MoO_3-WO_3$ the phase relationships between molybdates and tungstates are established. An unexpected trimolybdotungstate $Li_2(Mo_{1-x}W_x)_3O_{10}$ ($0.1 < x < 0.8$) is obtained in spite of the non-existence of the pure trimetallates. Several miscibilities between molybdates and tungstates are observed. (auth)

27358 THERMIONIC EMISSION BY TRANSITION METAL DODECABORIDES. Samsonov, G. V.; Okhremchuk, L. N.; Podchernyaeva, I. A.; Fomenko, V. S.; Odintsov, V. V. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 2, 231-233(Feb 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 2, 270-272(Feb 1974).

The thermoemissive properties of the cubic borides of the rare earth metals of the yttrium subgroup were investigated using compact specimens and powders. It was found that the effective work function of these dodecaborides depends on the nature of the component atoms. (auth)

27359 USE OF X-RAY PHASE AND IR-SPECTROSCOPIC ANALYSIS TO INVESTIGATE THE PRODUCTS OF THE REACTION OF LANTHANUM OXIDE WITH CRYOLITE. Belov, S. F.; Petrov, K. I.; Gladneva, A. F.; Kirillov, Yu. B. (Moscow Inst. of Fine Chemical Tech.). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 2, 237-239(Feb 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 2, 276-278(Feb 1974).

X-ray phase and ir-spectroscopic annlyses have revealed that when La_2O_3 dissolves in fused cryolite at 1050°C in the system Na_3AlF_6 - 25 wt % La_2O_3, $NaLaF_4$ is formed in the clear and bottom phases. On the basis of ir-spectroscopic analysis, it is postulated that the oxygen from La_2O_3 is combined as an oxyfluoride complex of Al. Sintering of specimens containing 35 or 50 wt % La_2O_3 leads to formation of lanthanum aluminate $LaAlO_3$ as well as $NaLaF_4$. (auth)

27360 SOLID SOLUTIONS IN THE SYSTEM HfO_2-TiO_2. Kocheregin, S. B.; Kuznetsov, A. K. Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 2, 254-256(Feb 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 2, 297-299(Feb 1974).

Phase relations in the subsolidus region of the system HfO_2-TiO_2 in the range 1150 to 1600°C were investigated. The presence of solid solutions based on HfTiO was established. At 1600°C the region of solid solutions extends from 33 to 55 mole % TiO_2. In the range 100 to 1000°C an investigation was made of thermal expansion of composition with 35.4 and 50 mole % TiO_2 and of the effect of heat treatment on expansion of the composition $(HfO_2)_{0.65}(TiO_2)_{0.35}$. The polymorphic transition temperatures of HfO_2-based solid solutions were determined. (auth)

27361 FORMATION MECHANISM OF BARIUM NIOBATE WITH THE TUNGSTEN-BRONZE STRUCTURE. Bois, G. V.; Gindin, E. I.; Zhukovskii, V. I.; Mikhailova, N. A.; Prokhvatilov, V. G. Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 2, 257-258 (Feb 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 2, 300-302(Feb 1974).

Formation reactions in the mixture $BaCo_3-Nb_2O_5$ were studied. It was found that formation of barium niobate with the tungsten-bronze structure in the mixtures $BaCO_3-Nb_2O_5$ takes place in the presence of additives, incorporation of which into the $BaNb_2O_6$ lattice leads to its distortion and conversion to a structure of the $PbNb_2O_6$ type. Formation of a structure of the $PbNb_2O_6$ type in the mixtures $BaCO_3-Nb_2O_5-TiO_2$ takes place via formation of the intermediate compound $Ba_5Nb_4O_{15}$ above 650°C; reaction of this compound with TiO_2 and Nb_2O_5 leads to formation of the tungsten-bronze structure above 850°C. Reaction in the mixtures $BaCO_3-Nb_2O_5-La_2O_3(CeO_2)$ takes place via formation of the intermediate compounds $Ba_2Nb_4P_{15}$ and $BaNb_2O_6$; reaction of the latter with La_2O_3 and CeO_2 above 1050°C leads to formation of the tungsten-bronze structure. (auth)

27362 HARDNESS OF DODECABORIDES OF METALS WITH THE UB_{12} STRUCTURE. Odintsov, V. V. (Kherson Pedagogic Inst., USSR). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 2, 317-318(Feb 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 2, 366-367(Feb 1974).

The microhardness of rare earth and zirconium dodecaborides was studied. The microhardness for these phases was found to be 3200, 3000, 2600, 2400, 2700, 2800, 3000, and 2900 kg/mm^2 respectively for YB_{12}, ZrB_{12}, TbB_{12}, DyB_{12}, HoB_{12}, ErB_{12}, TmB_{12}, and LuB_{12} (at a load of 100 g). For yttrium dodecaboride, splitting is observed at loads of 50 g or more ($H = 3300\ kg/cm^2$). The higher values of the microhardness, together with the low values of the thermal expansion coefficient and the high melting points of the dodecaborides are due to strengthening of the interatomic bonds in dodecaborides of metals in comparison with other boride phases, and in particular to the presence of predominant covalent B-B bonds. (auth)

27363 THERMOPHYSICAL PROPERTIES OF CARBIDES OF Ti, Zr, Hf, AND Nb AT 50 TO 1000°C. Buravoi, S. E.; Taubin, M. L. Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 2, 319-321(Feb 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 2, 368-369(Feb 1974).

Results of the investigation are presented in tables of data on coefficients of thermal conductivity and specific heat. Data on the temperature dependencies of the thermal conductivities of the carbides are presented in graphs. Discussions of these data are included. (JRD)

27364 KINETIC OF PREPARATION OF ZrN FROM THE GAS PHASE. Emyashev, A. V.; Martynov, S. Z.; Pavlov, Yu. A. Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 2, 322-323(Feb 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 2, 370-371(Feb 1974).

The kinetics of ZrN deposition from gaseous mixtures of $ZrCl_4$, N_2, and H_2 on graphite were studied. Data on properties of the ZrN coatings are given along with data on growth rates. The reaction kinetics of solid ZrN deposition are expressed by equations. (JRD)

27365 INFLUENCE OF TEMPERATURE ON FRICTION AND WEAR IN BORIDE COATINGS ON Mo. Sychev, V. V.; Tkachenko, Yu. G.; Koval'chenko, M. S.; Yurchenko, D. Z.; Sosnovskii, L. A.; Kelim, V. D. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 2, 222-226(Feb 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 2, 259-264(Feb 1974).

The temperature dependence of the coefficient of friction and the wear of α-MoB coatings on molybdenum was studied. The coefficient of friction and the wear rate have a minimum at 800 to 1000°C. The fine structure of the boride coatings were investigated at 20 to 1500°C. Friction of molybdenum boride at elevated temperatures is accompanied by two competing pro-

cesses—increasing degree of strengthening of the material during frictional deformation, and recovery at high temperatures; these ultimately lead to weakening of the material as the temperature rises. (auth)

27366 METASTABLE AND EQUILIBRIUM PHASES IN DILUTE V–N ALLOYS. Potter, D. I. (Argonne National Lab., IL); Epstein, H. D.; Goldstein, B. M. Met. Trans.; 5: No. 9, 2075-2082(Sep 1974).

Alloys of vanadium containing 0 to 10 at. % nitrogen were prepared and aged at temperatures from 300 to 950°C. The nitrogen solvus line was determined and the discontinuities are discussed in terms of the phases coexisting with the α-phase at various temperatures. Aging temperatures greater than 550°C produced only V_3N in equilibrium with the α-phase. Aging at 550°C and below resulted in a sequence of transformations beginning with the precipitation of $V_{16}N$ from supersaturated α-phase. This transformation was followed by the decomposition of the $V_{16}N$ into two other metastable phases, termed V_xN and V_yN. Longer aging times at 550°C resulted in dissolution of V_yN and resultant large discs of V_xN precipitate. Further aging yielded V_3N. Except for the α-phase, the phases involved in this sequence have nitrogen atoms which are ordered. The crystal structures of both the vanadium atoms and the nitrogen atoms in V_xN and V_yN are presented and discussed. V_xN is shown to be bct while V_yN is bcc with respect to the vanadium atoms. The morphology of the precipitates is described and discussed in terms of their crystal structures. (auth)

27367 METHOD OF MANUFACTURING ZIRCONIUM OXIDE AND SALTS. Schoenlaub, R. A. US Patent 3,832,441. 27 Aug 1974. Filed date 16 Jul 1973. 6p.

A process is described for the production of calcium zirconate and zirconium oxide or their salts which is characterized by reacting the mineral zircon with limestone to form calcium zirconate and tricalcium silicate. The calcium zirconate is freed from the tricalcium silicate by simple thermal steps which transform the tricalcium silicate to a form which can be separated by physical means. After light milling, the calcium zirconate can be recovered from the gangue material by mineral dressing techniques. The relatively pure form of zirconate can then be treated with acids to form zirconium sulfate which in turn is treated with well-known reagents to form zirconium oxide or other zirconium compounds. (Official Gazette)

27368 VAPOR DEPOSITION METHOD. Branovich, L. E.; Fitzpatrick, W. B. P.; Long, M. L. Jr. (to Secretary of the Army). US Patent 3,825,440. 23 Jul 1974. Filed date 3 Apr 1973. 4p.

Isotropic boron nitride is vapor deposited onto a substrate by suspending the substrate in a hot reaction chamber the inner walls of which bear a deposit of anisotropic boron nitride. Either water or ammonium hydroxide is added to the reaction chamber while the temperature is maintained at about 850 to about 1600°C. (Official Gazette)

27369 INTERSTITIAL ORDER AND EMBRITTLEMENT IN Ta–C. Rao, P. (General Electric Co., Schenectady, NY); Thomas, G. Scr. Met.; 8: No. 9, x1vi-x1vii(Sep 1974).

The effects of carbon on the structure and mechanical properties of tantalum at 77, 196 and 300°K have been investigated. The alloys contained 0.76, 1.27, 1.53, and 2.05 at. %C as determined by ^3He activation analysis. Interstitial ordering was observed in all alloys with the formation and growth of aligned particles in ⟨110⟩ causing tweed contrast in electron micrographs. Analyses of electron diffraction patterns indicated that the fully developed single phase structure which is attained in Ta 1.53 and 2 at. %C corresponds to a tetragonal or orthorhombic ordered lattice of composition $Ta_{64}C$ or $Ta_{32}C$. A model to explain these structures based on carbon fluctuations on specific {110} Ta planes is suggested. The alloys become completely brittle and cleave along {110} when the ordered structure is fully developed i.e. when the carbon content is 1.53 at. % or more. It is suggested that this embrittlement results from the severe elastic strains which arise due to ordering such that the restrictions on the elastic compliances can no longer be maintained. (auth)

27370 MAGNETICALLY INDUCED LATTICE DISTORTIONS IN ACTINIDE COMPOUNDS. Lander, G.H.; Mueller, M.H. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. B 10: No. 5, 1994-2003 (1 Sept 1974).

The lattice parameters of a number of actinide compounds have been measured at low temperature by x-ray diffraction. The ferromagnets NpN and NpC exhibit rhombohedral distortions at T_c. The antiferromagnets NpP and NpAs exhibit tetragonal distortions, which are compatible with the magnetic symmetry. In NpP the lattice distorts when the magnetic structure becomes commensurate with the crystal lattice. In NpAs the tetragonal distortion occurs at T_c, at which temperature the magnetic structure is a commensurate 4+, 4− arrangement. However, the magnetic structure of NpAs transforms to the simple type−I (+ −) arrangement at 142°K, and the x-ray experiments indicate that the lattice becomes cubic again at this temperature. X-ray experiments on the antiferromagnetic compounds UAs, NpSb, NpS, UO_2, and NpO_2 have failed to detect any lattice distortions, $|(c-a)/a| \leq 3 \times 10^{-4}$, in the magnetically ordered state. By listing all compounds examined, the presence of cubic or lower symmetry below the ordering temperature may be correlated with exchange interactions in the magnetic structures. (auth)

27371 SINTERING BEHAVIOR OF ULTRAFINE NbC AND TaC POWDERS. Sautereau, J.; Mocellin, A. (Ecole Nationale Superieure des Mines, Paris). J. Mater. Sci.; 9: No. 5, 761-771(May 1974).

27372 X-RAY DIFFRACTION STUDIES OF THE THERMAL EXPANSION OF NEPTUNIUM DIOXIDE. Sudakov, L. V.; Kapshukov, I. I.; Solntsev, V. M. Sov. At. Energy (Engl. Transl.); 35: No. 2, 751-752(Aug 1973).

Translated from At. Energ. (USSR); 35: No. 2, 128(Aug 1973).

The thermal expansion coefficient of the crystal lattice of $NpO_{2.0010.01}$ was measured over the range room temperature to 1000°C, using the high-temperature x-ray diffraction method. The lattice constant of NpO_2 varies as a function of the temperature. Over the temperature range from room temperature to 700°C, the thermal expansion coefficient of neptunium dioxide remains constant at $9.5 \pm 0.15 \times 10^{-6}$ deg^{-1}; as the temperature rises, the linear expansion coefficient follows suit, to attain a value of $11.0 \pm 1.0 \times 10^{-6}$ deg^{-1} at 1000°C. (LK)

27373 ION BACKSCATTERING STUDY OF WSi_2 LAYER GROWTH IN SPUTTERED W CONTACTS ON SILICON. Borders, J. A.; Sweet, J. N. (Sandia Labs., Albuquerque, NM). pp 179-191 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

Helium ion backscattering has been used to study the reaction kinetics in samples composed of thin (~2200 Å) W films dc sputtered onto chemically cleaned P or B doped ⟨111⟩ single crystal Si substrates. At temperatures in the range 625 to 750°C, Si is observed to migrate into the W films and form a well-defined WSi_2 reaction layer. Typically, at 650°C, about 750 Å of W is consumed in four hours. A detailed comparison of the backscattering spectra indicates that the WSi_2 reaction layer grows approximately as t^n where $n \approx 1$ during the initial growth but then decreases to $n \approx \frac{1}{2}$ when the W films are over 30% reacted. An activation energy which characterizes the initial stage of WSi_2 layer growth is 63 to 71 kcal/mole for 35% W film reaction (2000 Å WSi_2 formed). This activation energy is somewhat higher than the 50 kcal/mole reported by other investigators for WSi_2 layer growth at temperatures over 850°C where layer growth was observed to be governed by $t^{\frac{1}{2}}$ kinetics. A preliminary estimate of the activation energy governing the beginning of the $t^{\frac{1}{2}}$ layer growth observed here is 60 ± 15 kcal/mole. Prior to complete reaction of W films aged in the temperature range 625 to 730°C, an upper limit of 2 at. % Si is observed for the Si concentration in the unreacted portion of the W film. (auth)

27374 EFFECT OF THE DIRECTION OF STRESSES AND OF THE SHAPE OF THE PROFILE, TAKING ELASTO-MECHANICAL PROPERTIES OF U_4O_9 AS AN EXAMPLE. Wawra, H. H. Ber. Deut. Keram. Ges.; 51: No. 5, 134-136(May 1974). (In German). 1 fig.; 1 tab.; 6 refs.

Maximum utilization of ceramic materials presupposes exact knowledge of their behavior under extreme conditions. For the first time, the elasto-mechanical behavior, under extreme conditions, of U_4O_9 (Young's modulus, G-modulus, Poisson's ratio) are investigated as a function of the direction of stresses giving numerical data. Although, for instance, the isotropic value of Young's modulus may be given as 15.98, it actually varies, when choosing certain preferential directions, between 25.245×10^{11} and 11.462×10^{11} dyn/cm^2 (the [100] and [111] orientation). The G-modulus varies, solely as the function of the profile shape, between 9.900×10^{11} and 5.799×10^{11} dyn/cm^2 (a variation range of 70%). Poisson's ratio (isotropic value: $\omega_i = 0.3575$) shows a still greater variation (depending on the direction) between 0.6188 and 0.1446. The results apply generally to all ceramic products. (auth)

Metals and Alloys

Refer also to abstract 28671.

Corrosion and Erosion

Refer also to abstract 28697.

27375 (AD-772958) CORROSION BEHAVIOR OF DEPLETED URANIUM–TITANIUM AND URANIUM–MOLYBDENUM ALLOYS. Levy, M.; Zabielski, C. V.; Sklover, G. N. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Mar 1973. 28p. (AMMRC-TR-73-11). NTIS $3.25.

The corrosion behavior of U–1.8 Mo, U–3.75 Mo, U–1.76 Ti, U–3.41 Ti, and unalloyed uranium was studied by means of electrochemical measurements. Active-passive behavior was exhibited in sulfuric acid, sodium hydroxide, ammonium hydroxide, sodium sulfate, sodium nitrate, sodium chromate, and ammonium chromate solutions. Chloride additions as small as 0.005 M destroyed passivity and caused pitting. Chromates, sulfates, and nitrates behaved as inhibitors in solutions containing low concentrations of chlorides. The U–Mo alloys were more resistant to corrosion in chloride solutions than the U–Ti alloys. (auth)

27376 (AD-773938) DYNAMIC OXIDATION MECHANISMS OF SELECTED RARE-EARTH-BASE ALLOYS. Technical Report (Final), 1 March 1972–1 December 1973. Lundin, C. E. (Denver Research Inst., Colo. (USA)). 15 Jan 1974. Contract N00014-67-A-0394-0006. 43p. NTIS $3.25.

The dynamic oxidation of selected rare-earth elements and rare-earth-base alloys were determined for bulk powders by thermal analytic and calorimetric technique. The principal parameters established were the ignition temperature and relative combustion energy. Various oxidation mediums were studied: air, pure oxygen, and solid oxidizers. The effect of particle size of powders on ignition and combustion efficiency was established. The effect of the structural characteristics of the binary alloy systems on dynamic oxidation was analyzed. The general conditions under which the powders would or would not burn were found to be critical and were delineated. The alloy system that ignited with minimum energy was the cerium-iron system. One of the alloys was capable of spontaneous combustion in air at room temperature. Several other alloy systems with minimal ignition energy were the cerium-zinc and the cerium-thorium systems. The experimental alloy systems were compared under the same conditions of testing with a commercial incendiary alloy. The alloy composition consisted of Mischmetal–4% Mg. It did not compare as well in properties as some of the above experimental alloy systems. (GRA)

27377 (AD-774256) STRESS CORROSION CRACKING OF URANIUM ALLOYS. Final Report. Czyrklis, W. F.; Levy, M. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Dec 1973. 17p. (AMMRC-TR-73-54). NTIS $3.00.

The study was carried out to determine the critical threshold intensity for stress corrosion cracking of several uranium alloys which are candidates for ballistic penetrator and nuclear shell applications. They include: U–¾ Ti, U–1 Mo–1 Nb–1 Ti–1 Zr, and U–¾ Mo–¾ Nb–¾ Ti–¼ Zr. The data are for alloys in the as-extruded condition only and will serve as baseline for future studies involving the solution-treated-and-aged alloys. (GRA)

27378 (AD-774325) EXPERIMENTAL INVESTIGATION OF THE EROSIVE CHARACTERISTIC OF 410 STAINLESS STEEL AND 6Al–4V TITANIUM. Ball, R.; Tabakoff, W. (Cincinnati Univ., Ohio (USA)). Dec 1973. 62p. (AROD-10223-8-E). NTIS $3.75.

An investigation of the erosive behavior of 410 stainless steel and 6Al–4V titanium was conducted. In the course of this investigation it was found that the velocity dependence of erosion is a function of the impingement angle and the behavior of this dependence varies with different materials. It was also found that the effect of increasing the specimen width is a function of both aerodynamic and material properties, as well as the size of the erodent particle. Grant's model for predicting ductile erosion was investigated for both 410 stainless steel and 6Al–4V titanium. It was found that the model adequately predicts the velocity dependence on both materials above an impingement angle of approximately 15°. Modifications were made in Grant's equation to improve the prediction of the angles of maximum erosion and the shape of the erosion curve. (GRA)

27379 (AD-774893) REFRACTORY INTERMETALLIC COMPOUND COATINGS. Final Report, January 1972–January 1974. Ficalora, P. J.; Srikrishnan, V.; Pecora, L. (Syracuse Univ., N. Y. (USA). Dept. of Chemical Engineering and Metallurgy). Jan 1974. Contract N00017-72-C-4424. 20p. NTIS $3.00.

The crystal structure, electronic configuration, and thermodynamics of $HfPt_3$ and $ZrPt_3$ are discussed. It is concluded that films of $HfPt_3$ and $ZrPt_3$ can be used as coatings for components subjected to high-temperature oxidizing atmospheres. (GRA)

27380 (AECL-4665) CORROSION OF Zr_3Al-BASED ALLOYS BY CARBON DIOXIDE AND A CARBON DIOXIDE–WATER VAPOUR MIXTURE. Part 2. The Oxidation Process. Cameron, D. J.; Unger, A. E. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jul 1974. 26p. Dep. NTIS (U. S. Sales Only) $4.50. AECL $1.00.

Topographic and metallographic examination of oxidized Zr_3Al-based alloy samples shows a complex oxidation process. The early stages of oxidation are characterized by the formation of oxide blisters associated with the α-Zr solid solution phase. The blisters grow to cover the surface in a white oxide layer. At the oxide-alloy interface, cracking at the grain boundaries of the matrix and the Zr_3Al–Zr_2Al interfaces is observed. Isolated or semi-isolated areas of Zr_3Al and Zr_2Al are consumed by a fragmentation and oxidation process. All these features are thought to be due to various types of oxygen diffusion which cause embrittlement. (auth)

27381 (KFK-1993) CHANGE IN MECHANICAL PROPERTIES OF CLADDING MATERIALS FOR FUEL PINS OF NUCLEAR REACTORS AFTER REACTIONS WITH CARBIDE FUELS. Sarikaya, Y.; Goetzmann, O. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). May 1974. 66p. (In German). Dep. NTIS (U. S. Sales Only) $6.50.

Unlike the attack in an oxide fuel pin, the chemical reactions between carbide fuel and its cladding do not cause a reduction in the thickness of the cladding wall. However, a change in the mechanical properties of the cladding materials is to be expected. The changes in mechanical properties of various cladding materials (austenitic stainless steels and vanadium alloys) caused by carburization of the cladding by carbide fuels were studied. Gas bonding (argon) as well as liquid metal bonding (sodium) was used in the tests. Uranium carbide served as carbide fuel. The results are given by diagrams on the mechanical short time properties of the materials, i.e., the yield strength, the rupture strength, and the rupture elongation. At temperatures around 600°C, the greatest effect on the mechanical properties of the cladding materials due to the uptake of carbon was measured. The rupture elongation at room temperature for the steel of type 1.4988, e.g., is lowered by carburization from 42% to 6.3% (with sodium bonding). The high temperature rupture elongation at 600°C, however, still reached 12.2% compared with 30% of the uncorroded specimens. The vanadium alloy VTi3Si1 experienced a reduction of the rupture elongation from 15 to 0.4% at room temperature. At 600°C, however, a high temperature elongation of 15.5%, practically the same value as for uncorroded specimens, could be measured. At lower temperatures, the uptake of carbon by the cladding is still low. At higher temperatures, a resolution and enlargement of the precipitates take place. The effect of sodium bonding on the accelerated transport of carbon from the fuel to the cladding was especially noticeable at higher temperatures (>600°C) and at higher carbon contents of the fuel (~5 equiv wt. % carbon). According to results of these investigations the austenitic stainless steels and the vanadium alloy VTi3Si1 appear to be useful cladding materials for carbide pins. (auth)

27382 (ORNL-TM-4552) CORROSION OF SEVERAL IRON- AND NICKEL-BASE ALLOYS IN SUPERCRITICAL STEAM AT 1000°F. McCoy, H. E.; McNabb, B. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 34p. Dep. NTIS $4.00.

The corrosion of several iron- and nickel-base alloys in supercritical steam at 3500 psi and 1000°F was measured to 15,000 h in TVA's Bull Run Steam Plant. Corrosion was measured almost entirely by weight change and visual appearance; a few samples were evaluated by more descriptive analytical techniques. The corrosion rates of low-alloy ferritic steels containing from 1.1 to 8.7% Cr differed by less than a factor of 2 in steam, but the rates varied drastically in air at 1000°F. Several modified compositions of Hastelloy N were evaluated and found to corrode at about equivalent rates; however, some compositions did corrode intergranularly. Of the alloys studied, the lowest weight gain in 10,000 h was 0.01 mg/cm² for Inconel 718 and the highest 10 mg/cm² for the low-alloy ferritic steels. (auth)

27383 CAUSES OF WELD HOT CRACKING IN COLUMBIUM-STABILIZED STEEL CONTAINING 16% Cr and 16% Ni. Dahl, W.; Duren, C.; Musch, H. Stahl Eisen; 93: No. 18, 805-812(1973).

Characteristics of cracks occurring in welded joints of austenitic steels were studied. Solidification cracks in the weld metal and fusion cracks in the heat-affected zones of the parent metal, and the weld metal in multilayered welds were examined. Relative merits of different methods of testing austenitic steels for their susceptibility to weld hot cracking were evaluated. Testing for deformability during a welding temperature vs. time cycle was con-

ducted. Test equipment and procedure are described. Reduction of area and tensile strength at different temperatures during heating and cooling of as-cast, as-wrought, and weld-metal specimens was observed. Metallographic examination of these specimens at different stages of the temperature cycle was conducted. Electron-beam microanalysis of the grain-boundary phases showed distribution of elements in the fused grain junctions. Evaluation of results, with special reference to the reactions taking place during welding and to the factors affecting the development of cracks is reported. (Corros. Abstr.)

27384 CORROSION RESISTANCE AND ELECTROCHEMICAL AND MECHANICAL CHARACTERISTICS OF Nb–Ti–Ta AND Nb–Ti–Cr TRIPLE ALLOYS. Andreeva, V. V.; Glukhova, A. I.; Dontsov, S. N.; Moiseeva, I. S.; Mel'nikova, L. V. Zashch. Metal.; 8: No. 1-2, 415-419(1972). (In Russian).

Experimental data are presented on the influence of individual elements on corrosion resistance and electrochemical and mechanical characteristics. The structure of Nb alloys with 5, 10 and 15% Ta and 5 and 10% Ti, tempered at 1100°C, was partially recrystallized, and that of alloys with the same Ta content and 20, 30, and 40% Ti—completely recrystallized. The corrosion resistance of triple alloys in H_2SO_4 and HCl solutions at 100°C and with a constant Ta content fell with increase in Ti content. When Ta content was raised at constant Ti content, corrosion rate fell slightly. At 15% Ta over the whole test potential range, anodic current density and corrosion rate were the higher, the greater the Ti content. 1 to 5% Cr in both Nb–Cr and Nb–Ti–Cr alloys had virtually no effect on resistance in H_2SO_4 and HCl at 100°C. The corrosion rate of alloys rose with increase in Ti content. (Corros. Abstr.)

27385 IN SITU METAL GAS REACTION STUDIES. Heinemann, K. (Stanford Univ., CA); Poppa, H. pp 30-31 of Proceedings of the Thirty-first Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (Ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

Results of studies are presented on the kinetic and microstructural aspects of high-temperature interactions of O and H with single-crystal Ni films. The studies were conducted in-situ in a differentially pumped UHV specimen chamber of a transmission electron microscope. Results are discussed in terms of grain orientation, oxide particle shape, and oxide particle size. (JRD)

27386 SURFACE FILMS ON ZIRCALOY-2 SAMPLES CRACKED IN NEUTRAL AQUEOUS NaCl BY STRESS CORROSION. Ploc, R. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 46-47 of Proceedings of the Thirty-first Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (Ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

The films were examined by transmission electron microscopy to determine their composition and to clarify the mechanism of continuous layer penetration by the salt solution. Computer calculations were used to analyze the microscopic patterns. A model of the crystal plane relations among the various corrosion products is included. (JRD)

27387 X-RAY STUDIES OF MICRODISTORTION OF THE SURFACE OF TUNGSTEN MONOCRYSTALS AFTER ELECTRO-EROSION PROCESSING. Zolotykh, B. N.; Kirillov, I. V.; Marchuk, A. I.; Rubtsov, N. G.; Chuzhko, R. K.; Yakunkin, M. M. Fiz. Khim. Obrab. Mater.; No. 3, 123-124(1974). (In Russian).

X-ray studies showed that localized dispersion and nonstationary sources of heat act on the surface of a metal during the discharge in electro-erosion processing. The temperature gradient may reach 10^4 to 10^6°C/cm. A complex tension state is formed on the surface, and the behavior of the surface at this point determines the rate of crack distribution and the onset of plastic flow. Small pulse lengths lead to the state of cold-hardening of the surface going to small depths. Stress in the metal is relaxed. (MWG)

27388 STUDY OF KINETICS OF HETEROGENEOUS REACTIONS BY THE ELECTROTHERMOGRAPHICAL METHOD. Grigor'ev, Yu. M.; Gal'chenko, Yu. A.; Merzhanov, A. G. (Inst. of Chemical Physics, Moscow). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 4, 76-81(Jul 1974). (In Russian).

Based on ignition of fine metallic wires electrically heated in gaseous oxidant flow, the investigation was carried out on the kinetics of high-temperature oxidation of Al, Ta, and W in oxygen at atmospheric pressure under conditions of fast-proceeding processes. Kinetic equations, characteristic of the laws of interaction between the given metals at reaction times less than 0.15 s were obtained. Interpretation of the macroscopic oxidation mechanism is given. (auth)

27389 THE OXIDATION OF INTERMETALLIC ZIRCONIUM ALLOYS IN OXYGEN AND STEAM AT 400°C. Tolksdorf, E. (Danish Atomic Energy Commission, Risoe, Metallurgy Dept.). Werkst. Korros.; 25: No. 6, 430-435(Jun 1974). (In German). 1 fig.; 1 tab.; 7 refs.

The oxidation behavior of some intermetallic zirconium alloys in oxygen and steam was studied. Depending on their behavior, the alloys can be divided into three categories: (1) selective oxidation of alloying elements in the case of the alloys $ZrAl_3$ and ZrSi; (2) Selective oxidation of Zr produced by rearrangement and enrichment of alloying elements in the case of Zr_4Sn, $ZrCu_3$, ZrNi, ZrV_2 and $ZrMo_2$; and (3) Oxidation control by mixed oxides in the case of ZrNb and ZrTa. The mechanism of the corrosion of $ZrAl_3$ and $ZrSi_2$ in steam is interpreted in terms of the selective attack of Al and Si respectively. (auth)

Preparation and Fabrication

Refer also to abstracts 26429, 27100, and 28673.

27390 (AD-772617) DISLOCATION ETCH PITTING IN HIGH-PURITY NIOBIUM. Walson, R. P.; Birnbaum, H. K. (Illinois Univ., Urbana (USA)). Dec 1973. Contract N00014-67-A-0305-0020. 11p. NTIS $3.00.

A technique for etch-pitting screw and mixed dislocations in high purity niobium is described. (GRA)

27391 (AD-775136) STUDY OF THE TEMPERATURE CONDITIONS FOR THE FORMATION OF THE SERVICE LIFE OF Ni–Cr–Si–B COATINGS. Antonova, E. A.; Appen, A. A.; Andrushchenko, P. S. Translated by R. E. Courville from Fiz. Khim. Obrab. Mater.; No. 5, 31-37(1972). 15p. (FTD-HT-23-611-74). NTIS $4.00.

Optimal temperature limits and other conditions are determined for the formation of metal-like coatings of the type Ni–Cr–Si–B on steels by dross technology from the technical powders of the initial elements. Microroentgen spectral analysis is used to determine the distribution of elements Fe, Ni, Cr, Si, and B throughout the thickness of the coating and in the boundary layer as a function of firing conditions and the duration of subsequent temperature holding. (GRA)

27392 (AD-776824) GROWTH OF CRYSTALS OF RARE EARTH–COBALT 1:5 COMPOUNDS. Final Technical Report, 1 April 1970–31 May 1972. Austin, A. E.; Miller, J. F. (Battelle Columbus Labs., Ohio (USA)). Jul 1972. Contract F33615-70-C-1477. 66p. (AFML-TR-72-132). NTIS $3.25.

Techniques were developed for the growth of single crystals of $SmCo_5$, $NdCo_5$, $Sm_{1-x}Nd_xCo_5$ and $PrCo_5$. The preferred method was by slow bridgeman drop of rare-earth rich melts in pyrolytic boron nitride containers. Large crystals, up to 2 × 1.5 × 1.5 cm of $SmCo_5$, were grown with low oxygen content of 50 to 75 ppM. X-ray topography and rocking crystal curves were used for characterization of single crystals of $SmCo_5$. The main crystal imperfections were low-angle (0.5 to 1.5°) boundaries and dislocations. It was shown that the low-angle boundaries pin magnetic domain walls with about 500 Oe magnetic fields needed for moving the domain walls. The vapor phase reduction of samarium tricyclopentadienyl and cobalt bicyclopentadienyl was demonstrated to yield Sm, Co, and Sm_2Co_{17} at 500°C. (auth)

27393 (AD-776970) PHASE TRANSFORMATIONS IN VAPOR-QUENCHED MOLYBDENUM AND MOLYBDENUM GOLD ALLOYS. Final Report, 15 March 1972–31 October 1973. Pilkington, G.; Antwi-Boateng, G.; Meyrick, G. (Ohio State Univ. Research Foundation, Columbus (USA)). Feb 1974. 73p. (AROD-8665-2-MC). NTIS $3.75.

Thin films of Mo and of metastable single-phased Mo–Au alloys were prepared by vapor-quenching and subjected to a variety of aging treatments while their microstructural characteristics were studied by high-resolution microscopy and through electric resistance measurements. When aged above 400°C, the alloys transformed by a complex process which involved competition among internal precipitation, surface precipitation, and evaporation of the gold. The transformation was associated with resistance changes that followed second-order kinetics, and activation energies that tended to increase as the transformation progressed. Depending upon the quality of the vacuum and the temperature of deposition, amorphous, fcc, and bcc modifications of Mo were produced. (auth)

27394 (CONF-720236-(Abstr.)) INTERNATIONAL SYMPOSIUM ON RECENT DEVELOPMENTS IN METALLURGICAL SCIENCE AND TECHNOLOGY, NEW DELHI, INDIA, FEBRUARY 1–6, 1972. Abstracts of Papers. (Indian Inst. of Metals,

New Delhi). 1972. 52p. Indian Inst. of Metals, New Delhi, $20.00 per set.

Abstracts are presented of 72 papers, arranged in sections dealing with physical metallurgy, iron and steel, process metallurgy, and fabrication and treatment of metals. (DLC)

27395 EFFECTS OF ION BEAM MILLING ON SURFACE TOPOGRAPHY. Pawar, P. G.; Duhamel, P.; Monk, G. W. (Commonwealth Scientific Corp., Alexandria, VA). pp 84-85 of Proceedings of the Thirty-first Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (Ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

Results of micro milling operations on Ni-W composites using Ar^+ ions at 6 kV are reported. Descriptions of surface topography are included along with scanning electron micrographs. (JRD)

27396 PREPARATION OF ZIRCONIUM ALLOYS FOR ION BOMBARDMENT AND TRANSMISSION ELECTRON MICROSCOPY. Koch, E. F.; Lee, D. (General Electric Corp., Schenectady, NY). pp 88-89 of Proceedings of the Thirty-first Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (Ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

The technique consists of using a modified twin-jet electropolishing method to prepare samples for Ni ion bombardment at elevated temperatures followed by further polishing to provide foils suitable for transmission electron microscopy. A typical bright field micrograph of a Zircaloy-2 specimen irradiated by 5 MeV Ni ions is included. (JRD)

27397 METHOD OF MASSIVELY HYDRIDING ZIRCONIUM-URANIUM ALLOY. Reed, E. L. (to North American Rockwell Corp.). US Patent 3,829,552. 13 Aug 1974. Filed Date 12 Oct 1969. 8p.

A process of massively hydriding zirconium-uranium alloy fuel elements is described. The process comprises slowly heating the alloy in a vacuum to a temperature of about 1500 to 1850°F., contacting said alloy with hydrogen until a preselected H/Zr ratio is obtained at a pressure substantially greater than atmospheric, isochorically cooling the resulting composition to at least a temperature no higher than approximately 1390°F., and then cooling the composition to ambient conditions. (Official Gazette)

27398 METHOD OF HEAT TREATMENT OF NIOBIUM AND ITS ALLOYS. Prokoshkin, D. A.; Vasil'eva, E. V.; Tret'yakov, V. I.; Lupakov, I. S. USSR Patent 352,882. 27 Feb 1973. Filed Date 18 Jun 1971. (In Russian).

A method is described to increase the elastic properties of Nb alloys before annealing in which cold plastic deformation is conducted with compression greater than 50%, and annealing is performed at 500 to 900°C. Unalloyed Nb, treated by this method, has an elastic limit of 56 kg/mm^2. (JPRS)

27399 METHOD OF PRODUCTION OF SINTERED TUNGSTEN MOLDINGS. Shigina, V. A. USSR Patent 349,486. 6 Sep 1972. Filed date 18 Mar 1970. (In Russian).

A silicon-alkaline additive and Al_2O_3 are introduced to W anhydride. This is followed by reduction, pressing and two-stage sintering. In order to create a find-grain structure and even distribution of grains through the cross section, La salt is additionally introduced to the initial W anhydride in quantities of 0.03 to 0.05% (as La oxide) in relationship to the W contained in the W anhydride. W moldings are used in electrical engineering and the motor vehicle industry for the manufacture of contacts for distributors and voltage regulators. (JPRS)

27400 EVALUATION OF THE EFFECT OF HEAT CONDUCTIVITY ON THE CRITICAL PARAMETERS OF ELECTRON-BEAM PROCESSING OF METALS WITH DAGGER FUSION. Gorelik, G. E.; Pavlyukevich, N. V.; Perel'man, T. L.; Rudin, G. I. Fiz. Khim. Obarb. Mater.; No. 3, 30-32(1974). (In Russian).

Solution of the simplest distance problem of Stefan was used for evaluating the effect of heat conductivity on the critical parameters of electron-beam processing with dagger fusion. (tr-auth)

27401 CHEMICAL PREPARATION AND PROPERTIES OF THE LANTHANIDE AND ACTINIDE METALS. Mueller, W. (Commission of the European Communities, Karlsruhe (F. R. Germany). European Inst. for Transuranium Elements; Universitaet des Saarlandes, Saarbruecken (F. R. Germany). Inst. fuer Analytische Chemie und Radiochemie). Chem. Ztg.; 97: No. 10, 531-538(Oct 1973). (In German).

10 figs.; 5 tabs.; 43 refs.

Lanthanide and actinide metals can be obtained from the corresponding oxides or halides by electrolysis in molten salts or by metallothermic reduction. Protactinium and thorium, which form volatile iodides, can also be prepared by the Van Arkel process, volatile lanthanides and actinides can be obtained by thermal dissociation of intermetallic compounds. Whereas the lanthanide elements are characterized by the presence of localized 4f electrons which participate only to a small extent in chemical bonding, the 5f electrons of the lighter actinides are delocalized. This different behaviour of 4f and 5f electrons is reflected also in some physical and chemical properties of the lanthanide and actinide metals, e.g., crystal structures and metal valency, vapour pressures, heats of solution, formation of alloys and intermetallic compounds. (GE)

27402 KINETICS OF HARDENING OF THE Ti ALLOY $TA_6V_6E_2$. Analysis of Structural Transformations During Annealing. Gueret, G.; Houssin, B.; Fries, J.; Cizeron, G.; Lacombe, P. (Paris Univ., Orsay, France). J. Less-Common Metals; 38: No. 1, 31-51(Oct 1974). (In French).

The kinetics of the structural hardening of $TA_6V_6E_2$ alloy (Ti-5.22% Al-5.46% V-2.25% Sn-0.65% Cu-0.624% Fe) during annealing, subsequent to a water quench from the ($\alpha + \beta$) field, were studied by changes of hardness and resistivity. Thermal treatments were carried out at temperatures between 200 and 550°C and for annealing times from 5 min to 3 weeks. Results may be interpreted on the basis of the Johnson-Mehl equation. Other complementary methods were also used such as x-ray diffraction, DTA, optical microscopy, and scanning microscopy combined with nondispersive x-ray analysis of the phase constituents. A possible interpretation of the successive transformations which occur with increasing temperature is offered; the results, in general, indicate that the different processes which occur are essentially controlled by the diffusion of V. (16 fig, 4 tables) (auth)

27403 GRAIN BOUNDARY DIFFUSION AND GROWTH OF INTERMETALLIC LAYERS: Nb_3Sn. Farrell, H.H.; Gilmer, G.H. (Bell Laboratories, Murray Hill, New Jersey 07974); Suenaga, M. J. Appl. Phys. 45: No. 9, 4025-4035 (Sept 1974).

A study of the formation of Nb_3Sn layers at the junction of pure Nb and a Cu-Sn alloy is presented, and the effect of grain boundary diffusion on the kinetics of the formation of the layers is assessed. Data at 700-800 °C imply that the layer thickness increases with a $t^{0.35}$ time dependence. This deviation from the usual $t^{1/2}$ law for a process whose rate is limited by volume diffusion through the growing layer had previously been explained using analytical expressions for grain boundary diffusion into a semi-infinite crystal. A numerical analysis of grain boundary diffusion with geometry appropriate to an intermetallic layer is presented, and the results imply that a fixed array of grain boundaries in the layer cannot cause appreciable deviation from a $t^{1/2}$ law for most systems. The flux to the growth interface required to form the layer normally causes the diffusion processes in the layer to approach steady-state conditions, which, in the case of fixed boundaries, precludes a large deviation from the $t^{1/2}$ law. Scanning electron micrographs of the layer at various stages of growth show that the average grain diameter increases with time at an appreciable rate. The measured grain growth rate is used in a simple steady-state layer growth expression to obtain a description which agrees with the experimental measurements. Other factors which can influence the formation rate of intermetallic layers are discussed. (auth)

27404 PREPARATION OF SINGLE PHASE β AND α CERIUM SAMPLES FOR LOW TEMPERATURE MEASUREMENTS. Koskimaki, D. C.; Gschneidner, K. A. Jr.; Panousis, N. T. (Ames Lab., Iowa (USA)). J. Cryst. Growth; 22: No. 3, 225-229 (May 1974).

A method for preparing close to 100% β cerium is reported. The method involves repeated steps of thermal cycling cerium samples between room temperature and liquid helium temperature followed by annealing for long periods at 75°C. The preparation of single phase α cerium by using a pressure-cooling-depressurizing cycle is described. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 28684-28694.

27405 (AD-772954) PHYSICAL PROPERTIES OF RARE EARTH-COBALT MAGNET MATERIALS. Final Report, 1 July 1972-31 March 1973. Chipman, D. R.; Jennings, L. D. Jr. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Nov 1973. 23p. (AMMRC-TR-73-52). NTIS $3.00.

To further define the various types of time dependences noted previously, attempts were made to return a sample to its original

state. Because of the failure of these, a series of samples with nearly identical properties is being investigated. Preliminary results are given. High temperature x-ray measurements were made of prism plane reflections. These yielded thermal expansion values in the basal plane showing no anomaly at the Curie temperature. The widths of the x-ray lines were a function of temperature and also of previous heat treatments. The width variations are reported in some detail and attributed both to bulk and surface effects. The temperature factor was measured and can be interpreted through a Debye temperature of 281. (GRA)

27406 (AD-772959) EFFECT OF TEXTURE ON THE CREEP AND STRESS RUPTURE PROPERTIES OF TITANIUM 4Al-4V. Final Report. Hodi, F. S. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Nov 1973. 17p. (AMMRC-TR-73-49). NTIS $3.00.

Results indicate a significant difference in the creep and stress rupture properties with orientation. Greater creep rates are observed in the longitudinally oriented specimens than in the transversely oriented specimens with superior rupture life for transversely oriented specimens. Specimens having a transverse orientation appear to follow the conventional power law for stress dependence of creep where dislocation climb is rate controlling; specimens having a longitudinal orientation appear to follow a stress dependence behavior indicating that dislocation glide may be rate controlling as in alpha zirconium. (auth)

27407 (AD-773177) TECHNOLOGY DEVELOPMENT FOR TRANSITION METAL-RARE EARTH HIGH-PERFORMANCE MAGNETIC MATERIALS. Final Technical Report, 30 June 1970-30 June 1973. Becker, J. J.; Benz, M. G.; Cech, R. E.; Charles, R. J.; Doser, M. (General Electric Co., Schenectady, N. Y. (USA)). 30 Jun 1973. Contract F33615-70-C-1626. 180p. (SRD-73-149; AFML-TR-73-238). NTIS $12.00.

The work covered three general areas: the origin of the coercive force in high-anisotropy materials, phase equilibrium and chemistry, and studies of new materials and processing variables. The coercive force of single particles was shown to be controlled by defects whose nature determines the behavior of magnetization discontinuities. Magnetic domain observations were used to measure domain wall energies in several cobalt-rare earth alloys. The domain behavior of sintered magnets was observed and correlated with their magnetic properties. (GRA)

27408 (AD-773673) PLANE STRAIN FRACTURE TOUGHNESS (KIC) DATA HANDBOOK FOR METALS. Final Report. Matthews, W. T. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Dec 1973. 92p. (AMMRC-MS-73-6). NTIS $4.00.

A compilation of plane strain KIC data is presented for metals manufactured in the USA and Europe, including 50 steels, 21 titanium alloys, 38 aluminum alloys, and one beryllium material. The data correspond to static loading in neutral laboratory environment. The effect of temperature is included in the tables along with the direction of testing, the form and size of the material, its composition and heat treatment, and the specimen type and size. (GRA)

27409 (AD-773807) THERMOLUMINESCENCE AND COLOR CENTERS IN RARE EARTH DOPED CERIA CRYSTALS. Land, P. L. (Aerospace Research Labs., Wright-Patterson AFB, Ohio (USA)). Dec 1973. 75p. (ARL-73-171). NTIS $3.75.

Properties associated with electron traps, color centers, and luminescent centers are described for nominally pure and rare earth doped, flux grown crystals of CeO_2. The published work on optical and electrical properties of Ceria and related areas are reviewed and discussed in relation to this work. Computer programs for the calculation of energies and frequency factors from glow curves are presented. (GRA)

27410 (AD-774190) URANIUM ALLOY METALLURGY: AN ANNOTATED BIBLIOGRAPHY. Murphy, M. M.; Colling, D. A. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Jan 1974. 109p. (AMMRC-MS-74-1). NTIS $4.50.

An annotated bibliography is presented of the work reported in the literature in the English language (1957-1973) on fabrication, mechanical and physical properties, physical metallurgy, and corrosion behavior of depleted uranium-base alloys. Also included are testing and preparation techniques and other studies for unalloyed uranium which are applicable to uranium alloys. (GRA)

27411 (AD-774471/7GA) RESEARCH AND DEVELOPMENT OF RARE EARTH-TRANSITION METAL ALLOYS AS PERMANENT-MAGNET MATERIALS. Technical Report, 1 January-30 June 1973. Ray, A. E.; Strnat, K. J. (Dayton Univ., Ohio (USA). Research Inst.). Oct 1973. Contract F33615-70-C-1625. 128p. (UDRI-TR-73-50; ARML-TR-73-276). NTIS $4.50.

The significant accomplishments of investigations conducted over the past three years are summarized. Topics covered include: the metallurgy and magnetic properties of the rare earth-cobalt-iron alloys R2(Co(1-x)Fex)17 with R = Y, Ce, Pr, Nd, Sm, and MM (Ce-rich mischmetal); the rare earth-cobalt binary phase diagrams Ce-Co, Pr-Co and Nd-Co; the sintering and magnetic properties of the mixed rare earth-cobalt alloys R(1-x)PrxCo5, R = Sm, Didymium and R(1-x)NdxCo5, R = Pr, Sm, Didymium. (GRA)

27412 (AD-774501) MATERIAL PROPERTIES STUDY. Volume 1. Response of Beryllium Structures to In-Depth Heating by Electron Beams. Final Report, March 1972-October 1973. Underwood, P. G.; Burford, A. O. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). Jan 1974. Contract DNA001-72-C-0055. 163p. (LMSC-B-259017(Vol. 1); DNA-3214F-1). NTIS $5.00.

An electron beam thermo-structural response study has been conducted to improve understanding of the response of structural elements to instantaneous in-depth heating. Six experiments were performed using the DNA SNARK electron beam generator to provide active data for the critical conditions of heating which were selected during an extensive pretest analysis. Dynamic measurements of longitudinal strain, tip displacement, and rear surface velocity history were obtained from strain gages, a high speed camera, and a laser interferometer, respectively. Results of the study show that current electron beam accelerators may be successfully employed as radiation sources in structural response experiments. An extensive correlation study was performed in which experimental responses were compared with analytical results from existing computer codes. (GRA)

27413 (AD-774708) DYNAMIC BEHAVIOR OF PARAMAGNETIC IONS AND CONDUCTION ELECTRONS IN INTERMETALLIC COMPOUNDS: $Gd_xLu_{1-x}Al_2$. Rettori, C.; Kim, H. M.; Chock, E. P.; Davidov, D. (California Univ., Los Angeles (USA). Dept. of Physics). Feb 1974. Contract N00014-69-A-0200-4032. 33p. NTIS $3.25.

Electron spin resonance of Gd in $Gd_xLu_{1-x}Al_2$ intermetallic compounds exhibit significant changes in the g shift and thermal broadening upon (a) varying the Gd concentration, (b) adding a second nonmagnetic impurity, Th, and (c) varying the temperature. This behavior indicates the presence of the "bottleneck" and "dynamic" effects in the relaxation mechanism. The results were analyzed using a recent band calculation. The q-dependence of the exchange interaction and the spin-flip scattering rates of the conduction electrons caused by the Gd and Th impurities were extracted. Data are compared with previous results on isoelectronic systems $LaAl_2$ and YAl_2 doped with the same impurities. (auth)

27414 (AD-774710) STRUCTURE AND PROPERTIES OF INTERMETALLIC COMPOUNDS. Report No. 3 (Final), 1 October 1963-30 September 1971. Freise, E. J. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Materials Science). 1 Jan 1974. Contract Nonr-1228(31). 66p. NTIS $3.75.

Methods used to prepare both polycrystalline and single crystals of four different classes of intermetallic compounds are discussed. Research centered on determining either the optimum conditions for compound preparation or on correlating the modes of deformation under hardness or indentation loading with the type of bonding and crystal structure. Four major groups of intermetallic compounds were studied: TiNi and the closely related compounds TiFe and TiCo; transition metal silicides with emphasis on cobalt silicides; compounds having the nickel arsenide structure with major research being performed on NiSb; and refractory hard metals such as Mo borides, and carbides of Ta, Ti, Nb, and Mo. (GRA)

27415 (AD-774759) ASYMMETRICAL MECHANICAL BEHAVIOR OF A PRECIPITATION HARDENED BETA TITANIUM ALLOY. Tuominen, S. M.; Koss, D. A. (Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). Jan 1974. Contract N00014-72-A-0377-0001. 20p. NTIS $3.00.

Precipitation-hardened single crystals of a beta (bcc) Ti-40 at. % V-1.0 at. % Si alloy were deformed in compression at 77 and 298°K. The dependence of the yield stress upon aging time at 570°C for solutionized and quenched crystals shows two maxima, caused by the formation of silicide precipitates. The orientation dependence of the yield stress and of the active macroscopic slip plane were determined as a function of aging time. Results indicate that the effect of the dislocation core structure on dislocation motion is independent of the presence of precipitates, and that matrix hardening is independent of and additive to precipitation hardening. (GRA)

27416 (AD-775367) THERMAL CONDUCTIVITY STANDARD REFERENCE MATERIALS FROM 6 TO 280K. VI. NBS Sintered Tungsten. Hust, J. G. (National Bureau of Standards, Boulder, Colo. (USA)). Jan 1974. 59p. (NBSIR-73-351). NTIS $6.00.

Thermal conductivity, electrical resistivity, Lorenz ratio, and thermopower data are reported for two specimens of NBS sintered tungsten for temperatures from 6 to 280°K. Variability of this tungsten was studied by means of electrical resistivity and residual resistivity measurements on 39 specimens. These data indicate a material variability of about plus or minus 10% in thermal conductivity at helium temperatures. Above 90°K, variation in thermal conductivity is only about plus or minus 1%. To reduce the uncertainty caused by specimen variation at low temperatures, characterization by residual electrical resistivity data is described. By this procedure the low temperature uncertainty is reduced to about plus or minus 3%. (auth)

27417 (AD-775466) NONDESTRUCTIVE TESTING TECHNIQUES FOR DIFFUSION BONDED TITANIUM STRUCTURES. Final Report, 1 December 1972–1 October 1973. Regalbuto, J. A. (General Dynamics Corp., Fort Worth, Tex. (USA). Convair Aerospace Div.). Dec 1973. Contract DAAG46-73-C-0067. 130p. (AMMRC-CTR-73-53). NTIS $4.75.

Establishment of nondestructive testing techniques for diffusion bonded structures fabricated from Ti–6Al–4V sheets and forgings is reported. Ultrasonic shear waves, radio frequency and signal-averaged pulse-echo techniques, x-ray, fluorescent penetrant, and blue-etch-anodize were used to inspect a series of diffusion bonded defect specimens. Analysis of NDT, mechanical property, and fractographic data indicated that shear wave inspection of the sheet material could be correlated with the observed decrease in fatigue life with deflect concentration. Shear strength of the sheet specimens was not affected by the presence of the internal defects to any measurable degree. Grain structure noise limited inspectability of the small (0.006-in. dia) defects in the diffusion bonded forging. (GRA)

27418 (AED-CONF-74-079-003) MAGNETIC PROPERTIES OF PLASTICALLY DEFORMED GADOLINIUM SINGLE CRYSTALS. Hof, H. J.; Kronmueller, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany); Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Theoretische und Angewandte Physik). 1974. 8p. (CONF-740323-1). INIS.

From spring meeting of the Working Group on Magnetism of the Deutsche Physikalische Gesellschaft e.V.; Braunschweig, F. R. Germany (26 Mar 1974).

6 figs.; 16 refs. With abstract.

The magnetization curves of plastically deformed Gd single crystals were investigated in the temperature range between 200°K and the Curie point. The dependence of the deformation on the parameters of the Rayleigh region could be explained by the magnetoelastic coupling between domain walls and dislocations. The dislocation density was found to increase linearly with the strain. The differential susceptibility in the approach to saturation was found to be composed of three contributions: paraprocess, non-magnetic inclusions (Gd_2O_3), and spin inhomogeneities around dislocations. (auth)

27419 (AED-CONF-74-254-002) ELASTIC ANISOTROPY OF ZIRCALOY CLADDING TUBES SUBJECT TO BIAXIAL LOAD. Dressler, G.; Matucha, K. H.; Wincierz, P. (Metallgesellschaft A. G., Frankfurt am Main (F. R. Germany)). 1974. 8p. (In German). INIS.

From general meeting of the Deutsche Gesellschaft fuer Metallkunde e.V.; Bonn, F. R. Germany (4 Jun 1974).

8 figs. With abstract.

The elastic behavior of Zircaloy tubes, subject to biaxial load, of equal chemical composition and material condition is only dependent on the texture. On that account the theory of elasticity for isotropic materials is not suitable for predicting the material behavior. Taking into consideration the texture however, by examining adequately oriented single crystals, a good consistency between measured and calculated values is obtained. This consistency is quantitative for measurements at ambient temperature using the elasticity coefficients of α-zirconium. (GE)

27420 (AERE-Bib-151B) COMPENDIUM OF REFERENCES TO STUDIES OF THE PROPERTIES OF LIQUID METAL BINARY SYSTEMS WHICH RELATE TO THEIR STRUCTURE. Mott, B. W.; Stephenson, K. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jun 1974. 56p. Dep. NTIS (U. S. Sales Only) $6.00. UK £1.00.

References associated with about 210 binary alloys are presented. Marginal letter markings are included with each reference to designate the properties investigated. (JRD)

27421 (CONF-740606-20) ELEVATED-TEMPERATURE TRUE STRESS-TUBE STRAIN TENSILE BEHAVIOR OF AISI TYPE 304 STAINLESS STEEL. Diercks, D. R.; Burke, W. F. (Argonne National Lab., Ill. (USA)). Dec 1973. 25p. Dep. NTIS $4.25.

From pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

Data were obtained at true axial strain rates of 4×10^{-3}, 4×10^{-4}, and 4×10^{-5} s^{-1}, and temperatures of 900, 1000, 1100, 1200, and 1300°F. A modified closed-loop hydraulically activated fatigue-testing machine with hourglass specimens and diametral extensometry was used. Results indicate that the true stress at a given strain tends to decrease with an increase in temperature and a decrease in strain rate, particularly at the higher temperatures. The true axial strain to failure and the percent reduction of area are found to be significantly less for all temperatures at the slowest strain rate. The true stress–true strain data could be fit over most of the strain range using a modified form of an empirical equation suggested by Stowell. The Hollomon equation was applicable to a smaller strain range, and values for the strength coefficient and strain-hardening exponent in this strain range were obtained. (21 references, 8 figures) (auth)

27422 (ORO-3108-169) INVESTIGATIONS ON THE BEHAVIOR OF POINT DEFECTS AND DISLOCATIONS. Final Report. Kuhlmann-Wilsdorf, D. (Virginia Univ., Charlottesville (USA)). 1974. Contract AT(40-1)-3108. 36p. Dep. NTIS $5.00.

Summaries of research are presented on epitaxy, annealing of vacancies and interstitials, melting, structure of liquids, theory of work hardening and fatigue, theory of dislocation cells, surface stress, surface tension, phase transformations, precipitation, elastic constants, interatomic potentials, and radiation damage. (JRD)

27423 (ORO-3262-34) DEFORMATION PROCESSES IN REFRACTORY METALS. Progress Report, December 1, 1973–November 30, 1974. Donoso, J. R.; Reed-Hill, R. E. (Florida Univ., Gainesville (USA). Engineering and Industrial Experiment Station). 1974. Contract AT(40-1)-3262. 42p. Dep. NTIS $5.25.

Work was mostly concerned with the stress–strain behavior of Nb, as affected by dynamic strain aging. Also, an investigation of the effect of grain size on the work hardening phenomena associated with dynamic strain aging in Ti is being carried out. The dislocation structure in the dynamic strain aging region in Ti was studied, with the aid of transmission electron microscopy. (65 references, 19 figures) (DLC)

27424 (RFP–2048) EFFECT OF HUMIDITY ON TENSILE DUCTILITY OF URANIUM–TITANIUM ALLOYS. Jackson, R. J. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 1972. Contract AT(29-1)-1106. 27p. Dep. NTIS $4.50.

It was determined that a high relative humidity (RH) during tensile testing is detrimental to tensile ductility of the U–0.75 wt % Ti alloy. For example, longitudinal bars tested in 1% relative humidity showed percent elongations and reduction in areas in excess of 10%; while those tested at 99% RH had values less than 5%. Bars tested at intermediate humidities showed intermediate ductility values. The strain rate was 0.005 inches/inch/minute. Only one material condition was investigated: gamma quenched material aged 24 hours at 350°C. Transverse bars were also tested and these showed a corresponding, though smaller, loss in tensile ductility with high relative humidity. The mode of failure was observed and a mechanism is proposed to explain the observed behavior. (auth)

27425 CHANGE IN PHYSICO-MECHANICAL PROPERTIES DURING AGING OF MARTENSITE-AGING STEELS. Kondratov, V. M.; Krasnov, B. I. (Kirov Polytechnic Inst., USSR). Strength Mater. (USSR) (Engl. Transl.); 5: No. 8, 998-1001 (Aug 1973).

Translated from Probl. Prochnosti; 5: No. 8, 93-96 (Aug 1973).

The physicomechanical properties of Fe–Ni and Cr–Ni martensite aging steels in their normalized state and after aging were investigated. A change found in the lattice constant and resistivity of ferronickel and chromium–nickel martensite showed that diffusion of the alloying elements occurs over the temperature range 300 to 450°C. The relative amount of alloying elements that diffuses out of the α-solid solution is substantially greater in ferronickel than chromium–nickel steels. It was established that there is a relationship between the lattice constant or resistivity and the hardening during aging: the larger the decrease in the lattice constant or resistivity, the greater is the hardness of the martensite. The austenite formed during heating (at t = 550 to 650°C) is paramagnetic and stable with respect to the $\gamma \rightarrow \alpha$ transition. A further rise in temperature leads to destabilization of the austenite and causes it to be converted to martensite. The temperature at which stable austenite is formed and the destabilization temperature depend on the chemical composition of the base and the alloying-element content. (auth)

27426 EFFECT OF DEFORMATION ON THE STRENGTH AND PLASTICITY OF DILUTE CHROMIUM ALLOYS. Rakitskii,

A. N.; Tkachenko, V. G.; Trefilov, V. I. (Inst. of Metal Physics, Kiev). Strength Mater. (USSR) (Engl. Transl.); 5: No. 8, 981-984(Aug 1973).

Translated from Probl. Prochnosti; 5: No. 8, 77-80(Aug 1973).

The effects of cyclic thermomechanical treatments on low-temperature brittleness and mechanical properties of deformed Cr alloyed with rare earths were studied. It was found that alloying with small amounts of rare-earth metals increases the strength of deformed chromium at high temperatures. This is due to the inhibition of the softening processes caused by the rare-earth metal, which increases the recrystallization temperature and inhibits grain growth in chromium. Thus, for instance, the strength of a Cr + 0.8% La alloy deformed to 90% at 1000°C is 13 kg/mm^2, while that of pure chromium and the recrystallized Cr + 0.8% La alloy is 7.5 and 6.0 kg/mm^2, respectively. (JRD)

27427 RECOVERY PROCESSES DURING CREEP IN MOLYBDENUM AND ITS ALLOYS. Marushi, O. I.; Zasimchuk, E. E. (Inst. of Strength of Materials, Kiev). Strength Mater. (USSR) (Engl. Transl.); 5: No. 8, 936-939(Aug 1973).

Translated from Probl. Prochnosti; 5: No. 8, 34-37(Aug 1973).

Creep processes in Mo and dilute Mo-base alloys containing Zr and Ti additions were studied. It was found that the recrystallization zone forms due to polygonization processes developing in the second stage of creep. The regeneration of the most strongly disoriented low-angle boundaries into high-angle boundaries within grains which grow either in the earlier stages of testing or in the preliminary annealing process takes place by continuous climb of dislocations in them, the dislocations being introduced into the material during high-temperature deformation and linked with the scattering of previously formed subboundaries (with the growth of the subgrains). This process is the result of high-temperature creep flow and is not connected with the structural imperfections of the initial material, because it is also observed in molybdenum single crystals which have been carefully polished prior to testing and in polycrystalline molybdenum which has been given a preliminary high-temperature annealing. Migration of the high-angle boundaries which form at the end of the second stage (recrystallization zone formation) clears the microvolume of material of dislocations and contributes to its more rapid deformation. This result is of both scientific and practical interest, because it reduces the problem of stabilizing deformation and increasing long-term strength in practical heat-resistant materials based on high-melting metals to a problem which is already solved: that of finding effective ways of retarding polygonization and recrystallization. Thus accelerated deformation (onset of the third stage of creep) under high-temperature creep conditions in molybdenum and its alloys is linked with diffusion recovery processes (polygonization and recrystallization), which are stimulated not by preliminary deformation of the material but by deformation in the process of creep. (auth)

27428 ENTHALPY OF LIQUID SODIUM TO 1505°K BY DROP CALORIMETRY. Fredrickson, D. R.; Chasanov, M. G. (Argonne National Lab., IL). J. Chem. Thermodyn.; 6: No. 7, 629-633(Jul 1974).

The enthalpy (relative to 298.15°K) of liquid sodium was measured to 1505°K, using a high-precision drop-calorimetric system. The following equation represents the enthalpy of liquid sodium in the temperature range from 554 to 1505°K: $H^0(T) - H^0(298.15\ K) = \{4.62436(T/K) + 8.44442 \times 10^{-4}(T/K)^2 - 5.92445 \times 10^5(T/K)^{-1} + 731.931\}\ cal_{th}\ mol^{-1}$. All temperatures are based on IPTS-68. Values of $\{H^0(T) - H^0(298.15\ K)\}$, $C_p^0(T)$, and $\{S^0(T) - S^0(298.15\ K)\}$ are tabulated. (auth)

27429 HEAT OF MELTING AND ELECTRICAL CONDUCTIVITY OF NIOBIUM AND RHODIUM AT THE MELTING POINT. Savvatimskii, A.I. (High-Temperature Institute, Academy of Sciences of the USSR). High Temp. 11: No. 6, 1057-1062 (July 1974).

The melting of niobium and rhodium has been investigated by the electrical-rupture method [1, 2]. In the case of the heat of melting E_m of niobium, there is agreement between the results and the measurements made by the stationary method in [3]. However, there is a discrepancy between the values of E_m for molybdenum previously obtained by the same method [1] and the results in [4]. Values have also been obtained for the E_m of rhodium and for the resistivity of niobium and rhodium at the melting point in the solid (ρ_s) and liquid (ρ_l) states. The possibility of measuring the emissivity coefficient of refractory metals and alloys during melting in the course of electrical rupture is discussed. (auth)

27430 THE THERMOELECTROMOTIVE FORCE OF SINGLE CRYSTALS OF REFRACTORY METALS. Kuritnyk, I.P.; Stadnyk, B.I. ("Termopribor," L'vov). High Temp. 11: No. 6, 1173-1175 (July 1974).

Equations of the form $E = A + Bt + Ct^2 + Dt^3$ are obtained experimentally for the temperature dependence of the thermo-emf. (AIP)

27431 THERMODYNAMIC PROPERTIES AND PHASE DIAGRAM OF TERNARY SODIUM ALLOYS. Neethling, A. J. (Atomic Energy Board, Pretoria). J. Chem. Thermodyn.; 6: No. 7, 707-710(Jul 1974).

Electromotive force measurements in the temperature range 670 to 760°K were used to determine the thermodynamic properties of sodium in ternary mixtures of sodium, cadmium, and indium. Darken's method was used to calculate the partial excess functions for the cadmium and indium. The solid-liquid equilibrium surface for the system was also determined using thermal analysis. The maximum equilibrium temperature recorded was 745°K. (auth)

27432 STRUCTURE OF NIOBIUM-TITANIUM-ZIRCONIUM ALLOYS. Diffuse Scattering of Electrons and X Rays in Alloys With 50 at. % Niobium. Lyasotskii, I. V.; Tyapkin, Yu. D. (Central Scientific Research Inst. of Ferrous Metallurgy, Moscow). Fiz. Metal. Metalloved.; 36: No. 6, 1260-1270(Dec 1973).

Electron microscope (microdiffraction) and x-ray methods are used to study the change in diffuse scattering for a series of alloys in the system Nb-Ti-Zr (50 at. % Nb) as a function of composition, heat treatment, and temperature. This scattering is described by means of displacement wave fluctuation in the alloys. Diffuse scattering was observed in all alloys studied in the form of individual areas located in the space of the reverse lattice within octahedrons formed by the {111} planes passing through the junctions of the reverse lattice of the initial body-centered cubic solid solution. Considering the general nature of diffuse scattering, it can be described by means of concepts of displacement wave fluctuation, distorting the body-centered cubic structure. The form of diffuse scattering and consequently the spectrum of displacement waves change regularly with changing relationship of the content of zirconium and titanium in the alloys. The flatter areas (in the form of a triple sheet at the edges of the octahedron) in the Nb-Ti alloy are transformed in the Nb-Zr alloy to hollow spherical areas displaced toward the center of the octahedron; the directions of the polarization vectors of the displacement waves are also changed. At the primary junctions of the solid body-centered cubic solution, diffuse scattering is also observed, changing from alloy to alloy in parallel with changes in scattering in the space between junctions of the reverse lattice. Diffuse scattering does not change significantly after heat treatment, or at various observations temperatures between -130 and +400°C. (JPRS)

27433 AGING STRUCTURE OF MARAGING STEEL. Ts'ai, C. K.; Chu, C.; Ho, C. C. (Iron and Steel Inst., Peking). Wu Li Hsueh Pao; 23: No. 3, 178-193(May 1974).

Transmission electron microscopy and electron diffraction studies were carried out in order to clarify the crystallographic properties of strengthening precipitates and aged structure in an ^{18}Ni maraging steel. By using various zonal diffraction patterns, the coexistence of the precipitates Ni_2Mo, Ni_3Ti and the dispersed reverted austenite was identified, and their orientation relationships with respect to the martensite matrix determined. It was shown that the close-packed plane and direction of the precipitates and the reverted austenite are parallel to those in the matrix. The Widmanstatten type morphology in the transmission electron micrographs of the aged structure is in fact a three-dimensional skeleton structure in which the length direction of the rod-like precipitates is parallel to one of the four ⟨111⟩ directions of the matrix. The true existence of the observed extended and piled-up dislocations needs further experimental verifications. The process of precipitation along dislocation lines is discussed and a possible mechanism of the cobalt-molybdenum interaction is proposed from the structural point of view. (JPRS)

27434 STRUCTURAL CHANGES UPON AGING OF MARTENSITE OF IRON-NICKEL-TUNGSTEN AND IRON-NICKEL-COBALT-TUNGSTEN ALLOYS. Yedneral, A. F.; Zhukov, O. P.; Perkas, M. D. (Central Scientific Research Inst. of Ferrous Metallurgy, Moscow). Fiz. Metal. Metalloved.; 36: No. 2, 339-346(1973).

The alloys N17V10, N15K15V10 and N15K20V10 were studied by diffraction electron microscopy. The structure of the alloys in the aged state, the structure of hardening phases, and the distribution and form of their segregations were studied. The structure of the alloys was studied after aging at 520, 550 and 600°C. Segregations rich in tungsten were found to be one of the products of decomposition of the solid solution of martensite Fe-Ni-W alloy. These segregations consist almost entirely of tungsten atoms and have a body-centered cubic lattice. At 440°C, a hexagonal close-packed phase based on Ni_2W is also formed. At 500°C and higher, there is also a stage of formation of tungsten segregations, but the phase separated is primarily an Fe_2W-based intermetallide. The segregations are formed heterogeneously on martensite crystal structural defects. The introduction of 15 to 20% Co causes the solid solution to stratify into microvolumes, some rich in iron and cobalt, others rich in tungsten and nickel. All of these decomposition products help to harden the alloy. (JPRS)

27435 LOWER ENERGY LIMIT ESTIMATION OF THE EFFECTIVE NEUTRON ENERGY RANGE ON THE EVALUATION OF IRRADIATION DAMAGE TO MATERIALS. Calculation of Relative Displacement Damage Rates in Anisotropic Elastic Neutron Scattering. Onchi, T. (Central Research Inst. of Electric Power Industry, Tokyo). Denryoku Chuo Kenkyusho Gijutsu Kenkyusho Hokoku; No. 72056, 1-25(Feb 1973). (In Japanese).

Present status of the fast neutron spectrum determination method is reviewed and, as an analytical approach to estimate the effective neutron energy range on the evaluation of irradiation damage to materials considering neutron spectra in irradiation positions, a calculational method of relative displacement damage rates in anisotropic elastic neutron scattering using the Kinchin-Pease model is proposed. The range of lower energy value E_L of the effective neutron energy range on the evaluation of irradiation damage to materials is estimated under the consideration of 60 ~ 95% significant value of total number of displacements from those calculational results. Discussions are included about the use of lower energy limit E_L. (JA)

27436 EFFECT OF NITROGEN, BORON, AND PHOSPHOROUS ON HIGH TEMPERATURE STRENGTH OF 18Cr-10Ni AND 18Cr-10Ni-Mo AUSTENITIC STEELS BEARING SMALL AMOUNTS OF TITANIUM AND NIOBIUM. Matsuo, T.; Shinoda, T.; Tanaka, R. (Tokyo Inst. of Tech.). Tetsu To Hagane; 59: 907(1973).

It has been previously reported that with the combined addition of small amounts of Ti and Nb the creep rupture strength of 18 Cr-8Ni austenitic steel is markedly increased. The effects of further addition of N, B, and P on the creep rupture properties of 18-10 and 18-10-Mo steels both bearing small amounts of Ti and Nb are studied. It is found that the combined addition of 0.1%N and 0.02%B to these steels is effective for increasing the rupture strength, and the addition of 0.3%P to 18-10-Ti-Nb-Mo steel is more effective, giving a high 700 C-10^4 h rupture strength of 17 kg/mm^2. The cause of the strengthening effects of the elements are discussed with relation to changes in distribution of carbide. (Corros. Abstr.)

27437 HYDROGEN SOLUBILITY IN 1:5 COMPOUNDS BETWEEN YTTRIUM OR THORIUM AND NICKEL OR COBALT. Takeshita, T.; Wallace, W. E.; Craig, R. S. (Univ. of Pittsburgh). Inorg. Chem.; 13: No. 9, 2282-2283(Sep 1974).

Pressure-composition isotherms for the YCo_5-H system are reported. For purposes of comparison YNi_5, $ThCo_5$, and $ThNi_5$ were also examined as possible solvents for hydrogen. Results seem to indicate that crystal structure is an important factor in the hydrogen adsorption by this type of compound. (JGB)

27438 GRAIN BOUNDARY MIGRATION KINETICS IN HIGH PURITY CADMIUM. Mudiare, E. Chicago; Illinois Inst. of Tech. (1973). 158p. University Microfilms Order No. 74-17,008.

Thesis (Ph. D.).

The kinetics of grain boundary migration in high purity cadmium has been investigated as a function of misorientation and temperature. Due to the large driving forces employed in this investigation it has been possible to study intrinsic boundary migration behavior of ⟨0001⟩ tilt boundaries, random boundaries, and special boundaries obtained in growth selection experiments. A linear velocity-driving force relationship was obtained for all orientations at all annealing temperatures. Further, a factor μ, indicative of the fact that only a certain fraction of the applied driving force is available for migration, was observed. Current migration theories propose that grain boundary orientation characterized by coincidence relationships have high mobilities by virtue of possessing low activation energies. Results of the study confirm the fact that coincidence type boundaries have high mobilities, even though intrinsic activation energies for most boundaries have comparable values. Hence, the higher mobilities of the coincidence type boundaries are due to higher pre-exponential factors. Furthermore boundary orientations characterizing results of growth selection experiments possess mobilities higher than those of coincidence boundaries. It is shown that the prevalence of such orientations in growth selection experiments is due to a combination of their high mobilities and a low value of μ. Solute effects have been observed in tilt boundaries with orientations deviating by a few degrees from the two principal coincidence relationships. (Diss. Abstr. Int., B)

27439 WORK FUNCTION MEASUREMENTS OF SINGLE CRYSTAL SURFACES BY THE FIELD EMISSION RETARDING POTENTIAL METHOD. Strayer, R. W. Corvallis, OR; Oregon State Univ. (1974). 77p. University Microfilms Order No. 74-18,283.

Thesis (Ph. D.).

Using the field emission retarding potential method, true work functions were measured for several monocrystalline substrates; the values obtained are the following:

W(110)	5.25 ± 0.02 eV
W(100)	4.63 ± 0.02 eV
W(111)	4.47 ± 0.02 eV
Ir(111)	5.76 ± 0.04 eV
Ir(110)	5.42 ± 0.02 eV
Nb(100)	4.18 ± 0.02 eV
Ni(100)	5.53 ± 0.05 eV
Cu(100)	5.10 ± 0.05 eV

The electron elastic and inelastic reflection coefficients from several of these surfaces were also examined near zero primary beam energy. (Diss. Abstr. Int. B.)

27440 ELECTRONIC ENERGY LEVELS AND MAGNETIC EXCITATIONS IN RARE EARTH METALS. Herbst, J. F. Ithaca, NY; Cornell Univ. (1974). 173p. University Microfilms Order No. 74-18,106.

Thesis (Ph. D.).

A. A systematic investigation of certain electronic properties of the rare earth metals is described. Calculations are performed with the renormalized atom method in which Hartree-Fock free atom solutions are initially computed; the wave functions are then renormalized to the Wigner-Seitz sphere and used to construct l-dependent Hartree-Fock Wigner-Seitz crystal potentials. The following results are obtained: (1) Recent spectral information together with the free atom solutions permit an estimate of the change in neutral atom correlation energy associated with changing the 4f electron count; contrary to experience with 3d transition metals, it is found that correlation effects are more significant in a configuration with one fewer 4f and one more 5d electron. (2) Band extrema and Fermi levels are placed. (3) The positions of occupied and unoccupied 4f levels are estimated in both a one-electron approach and a multielectron method taking screening and relaxation effects into account in a definite way. The one-electron approximation for the 4f levels fails to reproduce the results of recent photoemission experiments, while the multi-electron calculations are in good accord with experiment. The effective Coulomb interaction energy between two 4f electrons at the same site is reduced from the single-particle value of 27 ev to 7 ev with the inclusion of multielectron effects. (4) Hartree-Fock values for the 4s and 5s shell exchange splittings are compared with soft x-ray photoemission studies of the rare earth fluorides and oxides; the calculated 4s splittings are roughly twice as large as experiment while the 5s results are in almost precise agreement. (5) The computed 5s and 5p one-electron energies agree with recent photoemission work on the pure metals. B. Assuming a simple model for the compound SmS, calculations are performed which indicate a definite tendency toward the observed pressure-induced semiconductor-metal transition. The results support the hypothesis that the transition is associated with a change in 4f occupancy of the samarium ion. C. The derivation of spin wave spectra for the rare earth metals is considered. After a review of the standard methods and their application to the isotropic ferromagnet, cone, and helix, a more careful treatment of the same spin structures is described. The procedure is to introduce the magnon approximation in the indirect exchange Hamiltonian rather than to employ the usual assumption of an effective Heisenberg interaction among the local spins. For the isotropic ferromagnet there is no great contrast between the results of the two approaches, while conceptual as well as analytical differences appear for the conical and helical arrangements. Particular attention is given to the conditions necessary for the magnon spectra to be gapless, and the behavior of the spectra at small wavevector is investigated. (Diss. Abstr. Int., B)

27441 DISLOCATION VELOCITY MEASUREMENTS IN ULTRA-HIGH PURITY NIOBIUM SINGLE CRYSTALS AT LOW TEMPERATURES. Walson, R. P. Urbana, IL; Univ. of Illinois (1974). 136p. University Microfilms Order No. 74-14,637.

Thesis (Ph. D.).

The velocity of screw dislocations on {211} planes, mixed dislocations on {101} planes, and mixed dislocations on {211} planes has been investigated microscopically in ultra-high purity niobium single crystals using Berg-Barrett x-ray topographs and chemical etching techniques. The Berg-Barrett x-ray topographic technique was found to be unsatisfactory for resolving individual dislocations or slip lines in the niobium used in this investigation. Chemical etching on the other hand produced satisfactory results and allowed the study of individual dislocations. An asymmetry of the velocity of screw dislocations on {211} planes was observed between a state of compression and a state of tension at room temperature (298°K). Screw velocities were greatest on the {211}

twinning system and smallest on the {211} antitwinning system. However, this asymmetry on the {211} disappears, or even slightly reverses sign at 196°K. No asymmetry in the velocities of mixed dislocations on the {211} and {101} was observed at any of the temperatures studied. The screw and mixed dislocation velocities could be described by a power law dependence on stress; $v = v_0 (\tau/\tau_0)^{m^*}$ for all planes and at all temperatures studied. There is a decrease in the velocity-stress exponent m^* for all the dislocation types studied on decreasing the temperature from 298 to 196°K. The results were compared to various theoretical models. Neither the Peierls–Nabarro model, the sessile-glissile screw dissociation model, nor the solid solution hardening model, which have been developed to explain the low temperature macroscopic deformation of bcc metals, can fully explain the present observations over the conditions of stress and temperature used in this investigation. (Diss. Abstr. Int., B)

27442 ELECTRON MICROSCOPE STUDY OF INTERDIFFUSION AND COMPOUND FORMATION IN Ta–Au THIN FILMS. Tisone, T. C. (Bell Telephone Labs. Inc., Allentown, PA); Lau, S. pp 32-33 of Proceedings of the Thirty-first Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (Ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

Results of the study show that only one phase is formed during the interdiffusion, this being the TaAu compound. The transformation proceeds as a planar interface moving into the Au and Ta films and the rate of growth of the TaAu phase depends on the form of the underlying Ta film where the rate increases in the order Ta_2N, Ta(bcc) and βTa. The presence of voids in the grain boundaries of the TaAu phase indicate that the transformation takes place by mass transport through the grain boundaries. A more detailed kinetic study has shown that the activation energy for the transformation in the βTa–Au and Ta(bcc)–Au systems is the same but that the preexponential in the rate equation for the βTa system is larger by an order of magnitude. This is a result of the transformation taking place by grain boundary diffusion where the effective diffusion coefficient should then be proportional to the grain size of the TaAu phase. This is consistent with the order of magnitude difference in grain size observed in the TaAu phase in the two systems. (auth)

27443 STUDY OF GOLD DEPOSITS ON (001) MOLYBDENUM SUBSTRATES. Price, C. W. (Battelle Columbia Labs., OH). pp 38-39 of Proceedings of the Thirty-first Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (Ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

Several Au deposits on (001) Mo surfaces were examined by reflection electron diffraction (RED), single-stage parlodion replicas, extraction replicas, and selected-area electron diffraction (SAD). The deposits were formed using a Knudsen effusion cell in an ultra-high vacuum system capable of 1×10^{-10} torr. The Mo crystals were baked several hours at ~1050°C, and the depositions were made at various substrate temperatures. In spite of intensive precautions, evidence of an unidentified crystalline film frequently appeared in the RED patterns. The contamination was suspected to form by the decomposition of light hydrocarbons that were not trapped by molecular sieves, and it was eventually eliminated by the use of a titanium gettering system. Descriptions of the RED patterns are included along with micrographs. (JRD)

27444 EPITAXY OF MOLYBDENUM ON SAPPHIRE. O'Neal, J. E.; Rath, B. B. (McDonnell Douglas Research Labs., St. Louis). pp 40-41 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

Thin films of molybdenum were deposited by the electron beam evaporation method on single-crystal sapphire substrates to establish the effects of substrate orientation, deposition temperature, and evaporation rate on the structure, orientation, and morphology of the deposited films. The films were characterized by replication and high resolution reflection electron diffraction methods. The polycrystalline texture and single crystal orientation of the deposited films as a function of the various sapphire substrate planes and the temperature are summarized in a table. These results are interpreted in terms of atomic misfit and crystal symmetry. (auth)

27445 MICROSTRUCTURE OF A CoCrNiTa ALLOY SYSTEM. Rowe, A. P.; Asgar, K.; Bigelow, W. C. (Univ. of Michigan, Ann Arbor). pp 170-171 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Calitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

The effect of tantalum additions to a 40–30–30 CoCrNi alloy has been studied by electron diffraction, transmission and scanning electron microscopy, and energy dispersive x-ray analysis in an attempt to identify the microstructure associated with mechanical properties determined by a previous investigator. At 9.1% Ta, both the alpha and beta phases are solid solutions. At 13%, the alpha phase is well ordered in tantalum. At 13.8% a very fine (<50 Å) coherent precipitate is found. At 16.7% the precipitate particles are larger and some are not coherent. When the alloys are heat treated at 700°C for 20 hours, equilibrium is approached and α-Co_3Ta is found in the 9.1% composition. (auth)

27446 INTERFACIAL STABILITY AND MECHANICAL BEHAVIOR OF NICHROME–TUNGSTEN FILAMENTARY COMPOSITES. Burden, S. J.; Lawley, A. (Drexel Univ., Philadelphia). pp 182-183 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

The interfacial dependence of mechanical behavior in high-temperature Ni-alloy matrix composites reinforced with refractory metal wires is examined along with the effectiveness of diffusion barrier layers between fiber and matrix. W-wire reinforced nichrome composites were used in the investigations Y_2O_3 coating on the wires reduced but did not eliminate embrittlement. All composite strengths were essentially the same as those of the unreinforced matrix. Further studies are in progress on coatings and matrix materials. (JRD)

27447 INFLUENCE OF THERMO-MECHANICAL PROCESSING ON THE MICROSTRUCTURE OF BERYLLIA DISPERSED NICKEL ALLOYS. Grewal, M. S. (Gillette Co., Boston); Sastri, S. A.; Grant, N. J. pp 184-185 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

An investigation was conducted to study the dislocation substructures formed in beryllia dispersed nickel alloys as a function of cold work both with and without intermediate anneals. Two alloys, one Ni–1 vol % BeO and other Ni–4.5Mo–30Co–2 vol % BeO were investigated. The influence of the substructures produced by thermo-mechanical processing (TMP) on the high temperature creep properties of these alloys was also evaluated. The best creep properties were associated with a TMP, which resulted in a microstructure consisting of stable dislocation cells, the walls of which were pinned by BeO particles. (auth)

27448 PHASE TRANSFORMATIONS IN Co_5Sm. Rao, P.; Smeggil, J. G.; Koch, E. F. (General Electric Corp., Schenectady, NY). pp 186-187 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

Results of studies on the effects of heat treatments at ~750°C on the coercivity of Co_5Sm are reported. Crystals of Co_5Sm were heated at ~750°C for 10 days. It was found that a partial breakdown of hexagonal Co_5Sm to rhombohedral $Co_{17}Sm_2$ and disordered Co_7Sm_2 occurs under these conditions resulting in reduced coercivity. (JRD)

27449 PHASE TRANSFORMATIONS IN Ti–wt % Mo–3 wt % Al Kannan, V. C.; Fujishiro, S. (Air Force Materials Lab., Wright-Patterson AFB, OH). pp 188-189 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

The phase transformations were investigated using x-ray diffraction and transmission electron microscopy (TEM). Results are discussed in terms of TEM and bright field micrographs. (JRD)

27450 DISTORTION OF SPUTTERING SPOT PATTERNS OF SINGLE CRYSTALS DUE TO INCOMPLETE CONDENSATION. Hofer, W. O. (Gesellschaft fuer Strahlen-und Umweltforschung mbh, Neuherberg/Munich, Ger.). Radiat. Eff.; 21: No. 3, 141-144 (Mar 1974).

It is shown experimentally as well as theoretically that sputtering spot patterns of single crystals can seriously be influenced by the condensation process on the collector. This results in errone-

ous representation of the preferential emission regarding both the ejection characteristic and the intensity ratio of different ejection directions. (auth)

27451 FIELD-ION MICROSCOPY OF DILUTE SUBSTITUTIONAL SOLID SOLUTIONS. Page, T. F.; Ralph, B. (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), Ser. A; 339: No. 1617, 223-243(6 Aug 1974).

A systematic field-ion microscopy study of several iridium-based dilute substitutional solid solutions was performed. Alloys of iridium with zirconium, tungsten, rhodium, platinum, and ruthenium, having solute concentrations of between 0.1 and 5 at.%, were examined by direct-screen methods in order to establish the viability of differentiating atomic species solely by image contrast features arising from their differing response to the field-ionization-evaporation processes. Reliable species recognition in this way allows the structural and crystallographic relations between the solvent and solute species to be determined collectively from careful field-evaporation sequences. A method of manual numerical analysis of micrographs was developed which allows the salient contrast features from any one alloy system to be deduced. Further, the order of priority of various experimentally observed contrast features was determined as a function of several parameters. The reliability of such investigations is discussed in terms of both experimental techniques used and the presence of artefact contrast events (e.g., field-induced surface vacancies) created by the technique itself. As a direct means of investigating such structures at the atomic level, it is found that field-ion microscopy can supply information concerning the location of particular species and may also reveal some aspects of the surface electronic state of each atom species with respect to its coordinating surroundings. (auth)

27452 INFLUENCE OF THE STABILITY OF RCo_5-PHASES ON THEIR PERMANENT MAGNETIC PROPERTIES. den Broeder, F. J. A.; Westerhout, G. D.; Buschow, K. H. J. (Philips Gloeilampfabrieken N. V., Eindhoven (Netherlands). Forschungslaboratorium). Z. Metallk.; 65: No. 7, 501-505(Jul 1974).

8 figs.; 1 tab.; 6 refs.

The influence of the eutectoid decomposition of $CaCu_5$-type rare earth cobalt phases on their permanent magnetic properties is discussed. When heating in the temperature region of the eutectoid transition, the room temperature coercive force of $SmCo_5$ magnets exhibits a hysteresis, which is highly indicative of a solid state transformation. It is shown that a strong correlation exists between the cooling rate of sintered $SmCo_5$-magnets and the ultimately attained coercive force. The eutectoid decomposition of RCo_5 phases was found to depend strongly on the presence of impurities and on the annealing temperature. (auth)

27453 STACKING-FAULT PROBABILITY DETERMINATION IN HCP METALS AND ALLOYS. Ramous, E. (Padua Univ. (Italy). Istituto di Chimica Industriale). Z. Metallk.; 65: No. 7, 515-518 (Jul 1974).

1 tab.; 12 refs.

By x-ray diffraction the probability of the formation of stacking-faults was studied in some hcp metals. The behavior of titanium, zirconium, and some magnesium alloys were examined. The probability was determined by applying methods based on the measurement of integral breadth and on the Fourier analysis of the reflection shape. The results obtained by the two methods agree and indicate that for titanium and zirconium the probabilities assume values which are very similar. In magnesium alloys the presence of zinc in solid solution facilitates the formation of these defects, while for aluminium an analogous effect was not observed. (auth)

27454 EFFECT OF SELENIUM AND SULFUR ON THE WORK FUNCTION OF TUNGSTEN. Volkov, N.V.; Gus'kov, Y.K.; Kononova, Z.N.; Kostikov, Y.I. Sov. Phys.—Tech. Phys. 19: No. 1, 144-145 (July 1974).

The effect of selenium and sulfur on the work function of tungsten has been studied. For sulfur a thermionic—emission method based on the total current as a function of the sulfur vapor pressure and the cathode temperature is used. For selenium, a field—emission microscope is used at selenium flux densities of 10^{10}—10^{16} atoms/cm^2 and at tip tempertures of 300—1700°K. (auth)

27455 INVESTIGATION OF THE WORK FUNCTION OF A TUNGSTEN CATHODE AFTER BOMBARDMENT BY INERT—GAS IONS. Chistyakov, P.N.; Milovanova, R.A.; Lytkin, V.V. (Moscow Engineering Institute). Sov. Phys.—Tech. Phys. 19: No. 1, 148-149 (July 1974).

It is found that the work function of a polycrystalline tungsten cathode is reduced by 0.2—0.25 eV after treatment by a high—current glow discharge in an inert gas (argon) in comparison with the standard value of φ obtained when the treatment is carried out in vacuum. A similar reduction in φ has been found earlier for a molybdenum cathode. The experimental results are explained by the variation in structure of the cathode surface and penetration of inert—gas ions of comparatively low energy (up to 250 eV) into the tungsten crystal lattice. (auth)

27456 DETERMINATION OF INTERNAL DEFECTS AND DENSITY OF TUNGSTEN AND MOLYBDENUM PELLETS BY GAMMA-QUANTA ABSORPTION. Bibinov, S. A.; Mukhin, Yu. B.; Khasanov, B. Kh. pp 170-172 of Applied Nuclear Physics. Book 2. Collection of Works. Tashkent; Fan (1973). (In Russian).

A radioisotope device was developed for inspecting the production of refractory and heat-resistant materials (particularly W and Mo pellets). The device makes it possible to determine the presence of internal defects and density of W and Mo pellets of square and circular cross section by the absorption of gamma radiation using a scintillation detector. Laboratory tests showed the following possibilities of this method: inspection time less than or equal to three minutes, minimally determinable defect dimensions (pores, foreign inclusions)—0.1 mm, and determinable change of density—0.2 g/cm^3. (Referativnyi Zh.)

27457 EFFECT OF ALLOYING OF TITANIUM ON THE DROP IN PLASTICITY AT 500°C. Vavilova, V. V.; Kornilov, I. L.; Fatkullina, L. P. Fiz. Khim. Obrab. Mater.; No. 3, 74-78(1974). (In Russian).

The effect of alloying titanium with different elements soluble in α-titanium on the mechanism of aging of titanium and its alloys with oxygen was studied. Alloys of titanium, containing oxygen with zirconium or aluminum decreased the plasticity drop. Simultaneous alloying with both aluminum and zirconium significantly decreased the plasticity drop, and the product was practically no different from alloys of the same compositions without oxygen. On the basis of the results obtained, a new composition oxygen—containing titanium alloyed with aluminum and zirconium is proposed. It differs in its high thermal stability in long testing at 400 to 600°C (1000 h). (tr-auth)

27458 STRUCTURE OF THIN FILMS OF VANADIUM AND CHROMIUM. Palatnik, L. S.; Obol'yaninova, O. A.; Naboka, M. N.; Gladkikh, N. T. Fiz. Khim. Obrab. Mater.; No. 3, 60-63 (1974). (In Russian).

Electron graphs were used to study the phase composition of vanadium and chromium films prepared directly in a mass spectrometer, with control of the molecular bundle and residual gases. The effect of composition of the molecular beam on the vanadium film structure was shown. Under conditions of interaction of the V film with a carbon substrate, the carbide VC or the oxicarbide γ-VC was formed. (tr-auth)

27459 HEAT OF SOLUTION AND MODIFYING CAPACITY OF TRANSITION METALS IN ALUMINUM. Vertman, A. A.; Ermolaev, K. N. Fiz. Khim. Obrab. Mater.; No. 3, 42-45(1974). (In Russian).

Based on measurements of heat of solution of the 3d transition metals in liquid aluminum, the nature of the interaction in the melt is considered. This is necessary for clarifying the mechanism of the modification process. (tr-auth)

27460 EFFECT OF CADMIUM COATING ON THE DEFECTIVE ELASTICITY OF AN ELASTIC WIRE. Tsobkallo, S. O.; Balatskii, K. K.; Moskalev, A. S. Fiz. Khim. Obrab. Mater.; No. 3, 127-128(1974). (In Russian).

Results of systematic studies showed that the action of a cadmium coating in decreasing the limits of elasticity depends on the thickness of the coating. The effect is due to the larger difference in limits of fluidity of the Cd and the steel U9A studied. The decrease in the elastic limits due to an oxide film is associated with a difference in the mechanical properties. Localized stresses cause localized plastic deformations, also due to the decrease in elastic limits. (MWG)

27461 INTERACTION OF COBALT WITH ZIRCONIUM UNDER THE INFLUENCE OF SHOCK PULSES AND WITH SUBSEQUENT THERMAL PROCESSING. Dunaev, S. F.; Kuprina, V. V.; Slyusarenko, E. M.; Malov, V. S.; Sokolovskaya, E. M. Fiz. Khim. Obrab. Mater.; No. 3, 131-132(1974). (In Russian).

Metallographic and local x-ray spectral analyses were used to study the interaction of Co and Zr under the influence of shock pulses and in subsequent thermal processing. The composition and structure of the transition zone are determined by the initial state of the metals before the shock and the parameters of the shock. Thermal processing causes stratification in large samples. (tr-auth)

27462 SYSTEM Ce—Co—B. Bilonizhko, N. S.; Kuz'ma, Yu. B. (Lvov State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 2, 227-230(Feb 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 2, 265-269(Feb 1974).

Using x-ray-structural-analysis methods the system Ce—Co—B

was studied. Cross sections of the phase diagram at 800 and 400°C were constructed. Thirteen ternary borides were found in this system; data on the crystal structure are obtained for seven of these borides. The crystal structures of $CeCo_4B$, $Ce_2Co_{11}B_4$, and $Ce_2Co_7B_3$ form a homologous series based on the $CaCu_5$ and $CeCo_3B_2$ types. (auth)

27463 ELECTRICAL INHOMOGENEITY IN InSb CRYSTALS ASSOCIATED WITH THE FACE EFFECT. Abrikosov, N. Kh.; Laptev, A. V.; Mirgalovskaya, M. S.; Raukhman, M. R. (Inst. of Metallurgy, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 10: No. 2, 205-209(Feb 1974).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 10: No. 2, 240-244(Feb 1974).

The degrees of compensation were determined on weakly doped and compensated crystals of InSb, of the p and n types, with the face effect, grown in the B(111) direction from melts, and containing donor (Te) and acceptor (Zn) impurities in comparable concentrations. In compensated crystals of p-type and n-type InSb with the face effect ($K > 0.3$), the regions of greatest compensation are different: for p-InSb they are the on-face regions, and for n-InSb the off-face regions. The values of the face effect found from electrical measurements may differ markedly from the corresponding values of this parameter found from the atomic ratios; this difference increases with the degree of compensation of the material. The hypothesis is suggested that these regularities should also occur in other semiconductive crystals with the face effect crystallizing with lattices of the diamond or sphalerite types. (auth)

27464 STABILITIES OF ALLOY PHASES CRYSTALLIZING IN THE Al_2Cu STRUCTURE. Raynor, G. V. (Univ. of Birmingham, Eng.). J. Less-Common Metals; 38: No. 1, 91-94 (Oct 1974).

Correlations of the stability index I ($I = 10^4T/100\ T_p + (T_q - T_p)\ X$, where T_p, T_q are the mps of the component metals, T is the max stable temperature of the P-Q phase, and X is the Q content) with the kind of component metals are presented. The alloys covered include those of the transition metals, B, Si, Th, Zr, Hf, Mo, W, Ta, In, etc. (DLC)

27465 CRYSTAL STRUCTURE OF THE SO-CALLED $R.E._5Pd_2$ COMPOUNDS. Fornasini, M. L.; Palenzona, A. (Univ. of Genoa). J. Less-Common Metals; 38: No. 1, 77-82(Oct 1974).

The crystal structure of Dy_5Pd_2 was determined using single-crystal photographic data. The compound is cubic, $a = 13.529$ Å, space group Fd3m, and the elementary cell contains 68 Dy and 28 Pd atoms with three crystallographic sets partially filled. The $R.E._5Pd_2$ compounds, where R.E. = Tb, Ho, Er, Tm, Lu, and Y, are isotypic with Dy_5Pd_2, and their lattice constant values are reported. (auth)

27466 CRYSTAL STRUCTURE OF $ZrCuHg_2$ AND $HfCuHg_2$. Puselj, M.; Ban, Z. (Univ., Zagreb). J. Less-Common Metals; 38: No. 1, 15-18(Oct 1974). (In Dutch).

The x-ray analysis of the systems Zr-Cu-Hg and Hf-Cu-Hg was worked out partially. In the sections ZrHg-CuHg and HfHg-CuHg, the ternary phases $ZrCuHg_2$ and $HfCuHg_2$ were found. Both phases are cubic with cell constants $a = 6.96 \pm 1$ Å ($ZrCuHg_2$), $a = 6.97 \pm 1$ Å ($HfCuHg_2$), and the structures are of the B 32 type. (auth)

27467 THERMAL EXPANSION ANOMALIES OF RARE EARTH-Co COMPOUNDS. Buschow, K. H. J.; Miedema, A. R.; Brouha, M. (Philips Research Labs., Eindhoven, Netherlands). J. Less-Common Metals; 38: No. 1, 9-13(Oct 1974).

Determinations were made of the thermal expansion of the compounds $SmCo_5$, Sm_2Co_7, $SmCo_3$, Gd_2Co_{17}, $GdCo_5$, Gd_2Co_7, $GdCo_3$, and $GdCo_2$ in the range from room temperature to 700°C. With the exception of Gd_2Co_{17} all compounds show an abnormal thermal expansion below the Curie temperature. These results are in keeping with the pressure dependence of the Curie temperature observed for the rare earth-cobalt compounds. (auth)

27468 Eu-Pd SYSTEM. Iandelli, A.; Palenzona, A. (Univ., Genoa). J. Less-Common Metals; 38: No. 1, 1-7(Oct 1974).

The binary system Eu-Pd was investigated by differential thermal analysis, x-ray diffraction, metallography, and magnetic susceptibility measurements. Six intermetallic phases were found. Four of these, viz., Eu_5Pd_2, Eu_3Pd_2, EuPd, and $EuPd_2$, contain divalent europium; in the remaining two, $EuPd_3$ and $EuPd_5$, the europium behaves as a trivalent rare-earth metal. To allow comparison with EuPd, the structures of CaPd, SrPd, and BaPd were determined. (auth)

27469 METASTABLE SOLUBILITY LIMITS OF PRIMARY HCP SOLID SOLUTIONS QUENCHED FROM THE LIQUID STATE. Wang, R.; Kim, Y. B. (Univ. of California, Los Angeles). Met. Trans.; 5: No. 9, 1973-1977(Sep 1974).

The extension of metastable solid solubility limits of Ti, Zr, and Hf in hcp rare earth elements Gd, Tb, Dy, Ho, Er, and Lu, and including Sc and Y, were obtained by quenching alloys from the liquid state. Both the solubilities of Zr and Hf in host matrices were increased enormously beyond their equilibrium solubilities, however little increase can be made for Ti as the solute. The large extension of the solubility limits by quenching from the liquid state was attributed to the three unique factors associated with the liquid quenching, namely the high mutual solubility in liquid state, the phase transformation of $L \rightarrow \beta \rightarrow \alpha'$ (martensite) and the high cooling rate. However, the retainable metastable solubility at room temperature is invariant as long as the cooling rate is sufficiently high enough to carry the $\beta \rightarrow \alpha'$ transformation. The resulting solubility limits are described as the Ultimate Solubility Limits (USL) for the hcp structure and refer to the maximum amount of the solute that can be dissolved in the matrix without immediate depletion at room temperature. A correlation of this USL to the size factors and the relative axial ratios (c/a) between the solute and solvent of 24 alloy systems was established. The strong correlation of these limits to the c/a ratios is due to the strain-induced mechanism of phase transformation. (auth)

27470 EFFECT OF GRAIN BOUNDARY ORIENTATION ON CREEP AND RUPTURE OF IN-738 AND NICHROME. Woodford, D. A.; Frawley, J. J. (General Electric Co., Schenectady, NY). Met. Trans.; 5: No. 9, 2005-2013(Sep 1974).

Creep rupture specimens taken from directionally solidified ingots of IN-738 and Nichrome in which the grain boundaries were oriented longitudinally, transversely, and 45° to the stress axis have been tested over a range of temperature and stress. For both alloys, the ductility was appreciably higher in the longitudinal orientation; but in IN-738, the creep strength was higher in the other two orientations. The net effect on rupture life was small for the superalloy. The nichrome showed much greater scatter which was due partly to inhomogeneous deformation and local recrystallization at the higher temperatures. Because of the recrystallization, even the longitudinal specimens showed intergranular failure for nichrome. The microstructural features of intergranular cracking both internally and on the surface are documented. It is suggested that surface cracking may be an important contributory factor in leading to reduced life with decreased section size which is commonly observed in conventionally cast superalloys. (auth)

27471 STRUCTURE OF DIRECTIONALLY SOLIDIFIED TWO-PHASE Sn-Cd PERITECTIC ALLOYS. Boettinger, W. J. (National Bureau of Standards, Washington, DC). Met. Trans.; 5: No. 9, 2023-2031(Sep 1974).

The structure of Sn-Cd two-phase peritectic alloys directionally solidified at various values of G/v (temperature gradient in the liquid divided by growth rate) is reported. The minimum value of G/v as a function of composition required for the solidification of two-phase peritectic alloys with a planar liquid-solid interface is estimated using a simple constitutional supercooling stability criterion. At a value of G/v just below this minimum value, these alloys solidify with a nonplanar interface consisting of cells of α (the high temperature phase) and intercellular β (the low temperature phase). This produces a coarse rod-like microstructure consisting of rods of α phase imbedded in a β matrix. At a value of G/v above this minimum value, these alloys solidify with a planar interface which alternately deposits bands of α and β transverse to the growth direction. No coupled growth of α and β at a planar interface is observed in Sn-Cd two-phase peritectic alloys as was expected. To understand this, an analysis of coupled (eutectic-like) growth of two-phase peritectic alloys is presented and contrasted with the results of the Jackson-Hunt theory of lamellar eutectic growth. This calculation indicates that the coupled growth of two-phase peritectic alloys is unlikely on theoretical grounds. (auth)

27472 CRACK INITIATION AND GROWTH IN PLANE STRAIN, FULLY PLASTIC ZICALOY. Kass, J. N. (General Electric Co., San Jose, CA); Begley, J. A.; Andrejasik, H. J. Test. Eval.; 2: No. 4, 304-316(Jul 1974).

A fractographic study of crack extension in plane strain, fully plastic Zircaloy was conducted. Three specimen geometries were studied: double-edge notched, compact tension, and center notched specimens. Slip line solutions for these geometries predict high, moderate, and no stress elevation, respectively, ahead of the crack tip. These differences might be expected to produce different modes of crack extension. However, crack tip blunting effects were found to overwhelm geometry induced differences. Blunting was found in all three geometries. Stretched zone width was found to be $\sim J/\sigma_y$, or about 0.01 in., regardless of geometry. Several variations of blunted crack tip shape were observed for all three specimen types. Two methods of crack

extension were observed for all three geometries studied. In the first method ellipsoidal holes were found to nucleate and grow ahead of the main crack tip. Growth continued until the ligament between the main crack and the hole was less than the major axis length of the hole. The hole then joins the main crack by means of local strain instability. The second method consists of alternate sliding off in a zigzag fashion. J_{IC} was measured and found to be equivalent for all three geometries. (auth)

27473 STRAIN FATIGUE AND TENSILE BEHAVIOR OF INCONEL 718 FROM ROOM TEMPERATURE TO 650°C. Brinkman, C. R.; Korth, G. E. (Aerojet Nuclear Co., Idaho Falls, ID). J. Test. Eval.; 2: No. 4, 249-259(Jul 1974).

Results of tensile and fully reversed strain-controlled fatigue tests, conducted on three heats of Inconel 718 that had been subjected to different solution annealing and aging treatments, are presented. Tests were conducted at temperatures ranging from 22 to 650°C, with fatigue tests defining behavior over the cyclic range from 10^2 to 10^6 cycles to failure. Average best fit equations defining true stress-strain, strain-controlled fatigue, and cyclic stress-strain behavior are given for the two heat treatments characterized. Heat-to-heat variations in the elevated temperature tensile and fatigue behavior were found. Fatigue lifetime was seen to be dependent upon grain size, particularly at lower strain ranges. (auth)

27474 SNOEK PINNING OF DISLOCATION IN HIGH PURITY Nb. Quist, O. P.; Carpenter, S. H. (Univ. of Denver). Scr. Met.; 8: No. 9, x1vi(Sep 1974).

The dislocation–interstitial interactions in two purity grades of high purity niobium rod were studied by measuring the dislocation damping as functions of time, temperature, strain, amplitude, and applied stress. Data were obtained using a composite Marx oscillator with a resonant frequency of 50 kHz. Both grades of material exhibited a decrease in dislocation damping in the 0 to 60°C temperature range. The observed damping decrease is attributed to the pinning of dislocation by Snoek ordering of oxygen interstitial atoms in the strain field of the dislocation line segments. (auth)

27475 PHASE CHANGES IN HYDRIDES OF Nb. Buck, O. (Rockwell International, Thousand Oaks, CA); Thompson, D. O.; Wert, C. Scr. Met.; 8: No. 9, 1061-1066(Sep 1974).

Attenuation and resonant frequency in longitudinal oscillations were measured on monocrystalline rods of niobium hydride. The resonant frequency was about 13000 Hz. Hydrogen contents were 10^3 at. ppM H to less than 500 at. ppM. Based on results it appears that the acoustic attenuation peaks at 207 and 230°K represent two phase changes. Since the attenuation peaks are so sharp, the temperatures can be more precisely defined than can easily be done using electron diffraction patterns. The peaks in attenuation are accompanied by slight changes in resonance frequency at the temperatures of the maximum. Similar phases are found in deuterated niobium. (JRD)

27476 SPIN–POLARIZED ENERGY–BAND STRUCTURE, CONDUCTION–ELECTRON POLARIZATION, SPIN DENSITIES, AND THE NEUTRON MAGNETIC FORM FACTOR OF FERROMAGNETIC GADOLINIUM. Harmon, B.N. (Physics Department, Northwestern University, Evanston, Illinois 60201); Freeman, A.J. Phys. Rev. B 10: No. 5, 1979-1993 (1 Sept 1974).

Conduction–electron polarization, spin densities, and neutron magnetic scattering in ferromagnetic Gd metal were studied using the spin–polarized augmented–plane–wave (APW) method in a warped–muffin–tin–potential formulation. The spin–up and spin–down bands were found to be very similar in shape to the bands from a paramagnetic calculation, with the exchange splitting proportional to the amount of d character in the bands. It was also found that the conduction–electron spin density determined from the APW wave functions is of mostly d character. This dominance of the d–like wave functions for the spin–dependent interactions is explained by (i) the much greater overlap of the 4f states with the d–like wave functions as compared to the s–p wave functions; (ii) the nearly complete d character of the bands in the region of the Fermi surface. The magnetic form factor was calculated from the conduction–electron spin density and compared with the recent neutron magnetic–form–factor measurement of Moon, Koehler, Cable, and Child. The calculated spin density was found to have the same shape as the "diffuse" density derived by Moon et al. (including a negative but much smaller in magnitude spin density at the c site in the unit cell). After the inclusion of core–polarization effects we conclude that large nonspherical contributions with $Y_{33} - Y_{3-3}$, and Y_{40} angular dependence are needed to explain the experimental results. (auth)

27477 SPIN–WAVE DISPERSION AND EXCHANGE INTERACTIONS IN $Y_{0.90}Tb_{0.10}$ AND $Y_{0.90}Ho_{0.10}$ ALLOYS. Wakabayashi, N.; Nicklow, R.M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. B 10: No. 5, 2049-2054 (1 Sept 1974).

Neutron inelastic scattering experiments carried out on $Y_{0.90}Tb_{0.10}$ and $Y_{0.90}Ho_{0.10}$ at 4.7 °K show that well–defined spin waves exist in dilute alloys of the heavy rare earths Tb and Ho in yttrium metal. The measured spin–wave dispersion relations are satisfactorily described by a mean–lattice model together with the assumption that the exchange interaction $J(\vec{q})$ is related to the conduction–electron susceptibility $\chi(\vec{q})$ of yttrium and, hence, is common to both alloys. The $J(\vec{q})$ function deduced from the data possesses a peak, at the wave vector of the helical magnetic structures of the alloys, that is much larger than those measured for the pure rare–earth metals. This result is consistent with theoretical calculations of $\chi(\vec{q})$ by Liu, Gupta, and Sinha from the electronic energy bands for yttrium and with measurements of the magnetic structures of yttrium–rare–earth alloys as a function of composition and applied magnetic field. (auth)

27478 THE HEAT CAPACITY OF β–CERIUM BETWEEN 1.5 AND 23 K. Koskimaki, D.C.; Gschneidner, K.A. Jr. (Ames Laboratory–USAEC and Department of Metallurgy, Iowa State University, Ames, Iowa 50010). Phys. Rev. B 10: No. 5, 2055-2059 (1 Sept 1974).

The heat capacity of single–phase β–cerium has been determined between 1.5 and 23 K with special emphasis on the shape of the antiferromagnetic ordering peak. It is concluded that separate ordering occurs at 12.45 and 13.7 K for the two types of site symmetry. The lower–temperature peak is thought to be associated with ordering of the cubic sites and the upper peak with the ordering of the hexagonal sites. An analysis of the various contributions to the heat capacity is made. The magnetic heat capacity between 1.5 and 2.3 K exhibits an exponential behavior, yielding an energy gap of 2.92 K, and between 3.5 and 6.5 K it exhibits a T^3 behavior. (auth)

27479 A $Sm_2(Co,Fe)_{17}$ MAGNET WITH $(BH)_{max} = 12$ MG Oe. Heinrich, J.P.; Garrett, H. (Solid State Materials Branch, Air Force Materials Laboratory, Wright–Patterson Air Force Base, Ohio 45433); Allen, R.P. J. Appl. Phys. 45: No. 4, 1873-1874 (Apr 1974).

A sample of sputtered $Sm_2(Co_{0.7}Fe_{0.3})_{17}$ was found to have ${}_mH_c = 5600$ Oe and $(BH)_{max} = 12$ MG Oe after heat treatment. These are both record values for 2 : 17 alloys, and the energy product is a record value for an isotropic magnet. This material is the first 2 : 17 alloy to exhibit useful permanent–magnet properties. (auth)

27480 OPTICAL PROPERTIES OF MOLYBDENUM. I. EXPERIMENT AND KRAMERS–KRONIG ANALYSIS. Veal, B.W.; Paulikas, A.P. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. B 10: No. 4, 1280-1289 (15 Aug 1974).

A study of the optical properties and electronic structure of molybdenum is reported in a two–paper experimental and theoretical series. Reflectivity data between 0.5 and 6 eV are presented, and Kramers–Kronig analytical procedures used to determine the optical functions $\epsilon_1(\omega)$ and $\epsilon_2(\omega)$ are discussed. Procedures are discussed for obtaining suitable extrapolations of $R(\omega)$ in the ranges $\omega_{min} \rightarrow 0$ and $\omega_{max} \rightarrow \infty$. ($\omega_{min}$ and ω_{max} are the energy extremes of the measured spectral range.) A new method (for metals) is presented for optimizing the extrapolation $R(\omega)$ in the range $\omega_{min} \rightarrow 0$. Recently reported sum rules are evaluated to test the inversion procedures. (auth)

27481 OPTICAL PROPERTIES OF MOLYBDENUM. II. THEORY. Koelling, D.D.; Mueller, F.M.; Veal, B.W. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. B 10: No. 4, 1290-1297 (15 Aug 1974).

The interband contribution of the optical conductivity of molybdenum has been calculated in the range of 0.0 to 5.5 eV based on the indirect contribution to the joint density of states from transitions restricted to a narrow window about the Fermi level was also calculated in the two models. Again, similar results were obtained. A comparison of these to the frequency derivative of the imaginary part of the dielectric function shows similarities in critical structure. The indistinguishability of the optical properties for molybdenum computed from the two theoretical models suggests that for other systems, both models should be compared with the experimental facts. (auth)

27482 INTERDIFFUSION AND COMPOUND FORMATION IN Ta–Au THIN–FILM COUPLES. Tisone, T.C.; Lau, S.S. (Bell Telephone Laboratories, Allentown, Pennsylvania 18103). J. Appl. Phys. 45: No. 4, 1667-1674 (Apr 1974).

An investigation of the interdiffusion between sputter–deposited bilevel films of bcc Ta–Au, β–Ta–Au, and Ta_2N–Au has been carried out by using x–ray diffraction, electron microscopy, and electrical resistance measurements. In all three systems only the TaAu phase was observed to form. The temperature range of formation of the TaAu phase for the systems considered increased in the order β–Ta, bcc Ta, and Ta_2N. The resistance change for a given temperature increased in the order Ta_2N, bcc Ta, and β–Ta. It was concluded that the change of resistance occurred by three mechanisms: (1) diffusion of Ta into the Au grain boundaries, (2) diffusion of Ta into the Au bulk, and (3) transformation of the Au into a high–resistivity TaAu phase. From the resistance measurements the kinetics of the formation of the TaAu phase were found to be diffusion controlled with the diffusion species moving through the TaAu phase grain boundaries. (auth)

27483 OXIDATION OF Nb AS STUDIED BY THE UV–PHOTOEMISSION TECHNIQUE. Lindau, I.; Spicer, W.E. (Stanford Electronics Laboratories, Stanford University, Stanford, California 94305). J. Appl. Phys. 45: No. 9, 3720-3725 (Sept 1974).

The initial stages in the oxidation of Nb have been studied by the uv–photoemission technique for photon energies below 12 eV. Changes of structure in the electron distribution curves for different oxygen exposures and temperatures are correlated with formation of different types of Nb oxides. Electronic structure changes due to formation of at least three different oxides or mixtures of oxide have been observed. NbO_2 and the NbO oxides seem to form first as a thin protective layer. The pentoxide, Nb_2O_5, is obtained after heavy oxidation. Practical implications of the formation of NbO in the interface between Nb_2O_5 and Nb metal are discussed. (auth)

27484 ELASTIC CONSTANT INCREASES UPON CRYSTALLIZATION OF A SPUTTER–DEPOSITED AMORPHOUS ALLOY. Merz, M.D.; Allen, R.P.; Dahlgren, S.D. (Battelle Memorial Institute, Pacific Northwest Laboratory, Richland, Wahsington 99352). J. Appl. Phys. 45: No. 9, 4126-4127 (Sept 1974).

A 0.2–in.–thick amorphous samarium–cobalt alloy (Sm_2Co_{17}) was prepared by sputter deposition. Increases in shear and bulk moduli were measured before and after crystallization with an ultrasonic technique. The shear modulus increased 45% and the bulk modulus increased 7% upon crystallization. Density increases were less than 2%. The increases were in accord with theoretical predictions. (auth)

27485 ATOMIC ORDERING IN A15–TYPE PHASES IN THE VANADIUM–NICKEL AND VANADIUM–COBALT SYSTEMS. Waterstrat, R.M.; Dickens, B. (Institute for Materials Research, National Bureau of Standards, Washington, D. C. 20234). J. Appl. Phys. 45: No. 9, 3726-3728 (Sept 1974).

Atomic ordering in the V–Ni and V–Co A15–type phases has been studied using neutron diffraction. The V–Ni structure is shown to be ordered to the maximum extent permitted by the "off stoichiometric" composition, $V_{77.5}Ni_{22.5}$. The V–Co structure possessing the "ideal" composition $V_{75.0}Co_{25.0}$ is also highly ordered. However, the V–Co diffraction data are less accurate due to neutron absorption by the cobalt atoms and interference from the sample holder. No magnetic structures were detected in the V–Co phase at 4.2 °K. (auth)

27486 PRODUCTION OF CERTAIN MOLYBDENUM-BASE SINGLE-CRYSTAL ALLOYS AND INVESTIGATION OF THEIR STRUCTURE AND PROPERTIES. Bulgak, L. V.; Belomyttsev, Yu. S.; Savitskii, E. M.; Kapustin, V. D.; Saratovskii, L. N.; Pavlovich, T. M.; Zuykov, V. A. pp 10-16 of Struktura i Svoystva Monokristallov Tugoplavkikh Metallov. Moscow; Izd'vo Nauka (1973).

The possibility of increasing the heat resistance of Mo by means of introducing interstitial elements (C) and substitutional elements–carbide-forming (Zr, Nb), and not forming carbides (Ni), was studied. Mechanical properties of Mo alloys are tabulated. The high-temperature strength of Mo single crystals is substantially increased by small additions of Zr and Nb, whereupon the strengthening action is rendered by Zr. Results show that there are numerous precipitations of MoC in single crystals with carbon of which the sizes and amount increase with increased carbon content. Reasons are given according to which, despite a strengthening effect, the presence of MoC in the single crystals is undesirable. Addition of Ni leads to a substantial increase of ductility at room temperature in comparison with pure Mo. (Ref. Zh.)

27487 APPARATUS FOR DIFFERENTIAL THERMAL ANALYSIS AND THE PHASE DIAGRAM OF THE InSb–CdTe SYSTEM. Morozov, V. N.; Karnaukhova, E. N.; Skorobogatova, L. A.; Ryazantsev, A. A. (Inst. of Applied Physics, Irkutsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 4, 52-56 (Jul 1974). (In Russian).

The apparatus for DTA using the EPP-09 electronic automatic potentiometer as a recorder was described. The phase diagram of the InSb–CdTe system was examined by DTA. The compounds were found to form an eutectic mixture at 510°C (6 mol % of CdTe). ΔH_f of InSb and CdTe (10.7 + 0.9 and 9.5 + 0.9 kcal/mol accordingly) were determined. The interaction parameter B_1/RT as a function of composition was calculated. (auth)

27488 THE ELECTRICAL RESISTIVITY OF SOLID AND LIQUID Dy AND Ho. Guentherodt, H. J.; Hauser, E.; Kuenzi, H. U. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festkoerperphysik). Phys. Lett., A; 48: No. 3, 201-202(17 Jun 1974).

The electrical resistivity of Dy and Ho were measured from room temperature up to 1600°C. The values observed in the liquid state are 210 $\mu\Omega$ cm respectively and are therefore larger than for Gd and Tb. (auth)

27489 EPITHERMAL NEUTRON DIFFRACTION FROM A GADOLINIUM ALLOY ($Gd_{(0.9)}Y_{(0.1)}$). Ishikawa, Y.; Watanabe, N.; Tajima, K.; Sekine, H. (Tohoku Univ., Sendai (Japan). Dept. of Physics). Phys. Lett., A; 48: No. 3, 159-160(17 Jun 1974).

The first observation of the epithermal neutron diffraction from a natural Gd alloy is reported. A simple epithermal neutron diffraction has been constructed which enables making the neutron diffraction in an energy region between 0.35 eV and 5 eV. A rectangular single crystal of $Gd_{0.9}Y_{0.1}$ alloy of dimensions $5.5 \times 6 \times 7$ mm^3 was used in the experiment. Typical examples of T-O-F spectra obtained at room temperature for different scattering angles are shown. The coherent nuclear scattering amplitude of natural Gd was determined by epithermal neutron diffraction with neutron energy of 1.4 eV to be $1.4 \times 0.1 \times 10^{-12}$ cm. (auth)

27490 DENSITY OF STATES OF Nb AND Mo USING SLATER-KOSTER INTERPOLATION. Pickett, W. E.; Allen, P. B. (State Univ. of New York, Stony Brook (USA)). Phys. Lett., A; 48: No. 2, 91-92(3 Jun 1974).

Slater-Koster parameters are given which have been fit to APW band calculations for Nb and Mo. The density of states at the Fermi surface of the 4d bcc alloys agrees well with a rigid band interpretation of the calculated density of states. (auth)

27491 STOPPING POWERS OF Al, Ti, Fe, Cu, Mo, Ag, Sn, Ta, AND Au FOR 7.2 MeV PROTONS. Ishiwari, R.; Shiomi, N.; Shirai, S. (Department of Physics, Nara Women's Univ., Nara, Japan); Uemura, U. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). Phys. Lett., A; 48: No. 2, 96-98(3 Jun 1974).

Stopping powers of several metallic elements have been measured using a silicon detector. The present results are decisively lower than the data of Anderson et al. The deviations are statistically significant. The Nara data agree well with the table of Barkas and Berger. (auth)

27492 SIGN OF THE ELECTRIC FIELD GRADIENT IN Cd METAL. Raghavan, P. (Rutgers–the State Univ., New Brunswick, N. J. (USA)); Raghavan, R. S.; Kaufmann, E. N. (Bell Telephone Labs., Inc., Murray Hill, N. J. (USA)). Phys. Lett., A; 48: No. 2, 131-132(3 Jun 1974).

The sign of the quadrupole coupling constant e^2qQ of the 247 keV of ^{111}Cd metal is determined to be positive, using the β-γ PAC technique. With $Q > 0$, this implies a positive EFG for Cd verifying the recent theoretical prediction of Mohapatra et al. (auth)

27493 LOW TEMPERATURE LATTICE TRANSFORMATIONS OF $LaRu_2$. Lawson, A. C. (California Univ., La Jolla, San Diego (USA). Inst. of Pure and Applied Physical Sciences); Baberschke, K.; Engel, U. (Freie Univ. Berlin (F.R. Germany)). Phys. Lett., A; 48: No. 2, 107-108(3 Jun 1974).

At room temperature $LaRu_2$ has the fcc-$MgCu_2$ structure. Using x-ray powder diffraction it has been found that the low temperature structure has a body centered tetragonal lattice. At 6°K the lattice constants are $\sqrt{2}a = 7.663$ Å, $c = 7.773$. Because this represents only a slight distortion of the normal fcc structure, it seems probable that the transformation is martensitic. (auth)

Radiation Effects

Refer also to abstract 28589.

27494 (AD-775297) COOPERATIVE RADIATION EFFECTS SIMULATION PROGRAM. Semiannual Progress Report, 1 May–31 October 1973. Steele, L. E.; Wolicki, E. A. (Naval Research Lab., Washington, D. C. (USA)). Feb 1974. 110p. (NRL-MR-2755). NTIS $4.50.

Progress is reported in: (1) developing the NRL Code E-DEP-1 for energy deposition by heavy ions, (2) modifying the Manning and Pagett transport theory for the penetration of heavy ions near the surface, (3) an investigation of the total cross section corresponding to the differential cross section of Lindhard, Nielsen, and Scharaff, (4) an investigation of the temperature dependence of nickel-ion damage in nickel, (5) a study of the flux (dose rate) effects for 2.8-MeV $^{58}Ni^+$ irradiations of pure nickel, (6) studies of helium mobility in metals, (7) the cyclotron helium implantation facility, and (8) the effect of cyclotron implanted helium on the fatigue behavior and microstructure of 316 stainless steel at 650°C. (GRA)

27495 (AD-775516) RADIATION DAMAGE IN SOLIDS AND PHONON SCATTERING. Final Report, 1 July 1970–30 September 1973. Klemens, P. G. (Connecticut Univ., Storrs (USA). Dept. of Physics). 31 Oct 1973. (AROD-9190-10-P). NTIS $3.00.

Experimental and theoretical work was done on the use of phonon scattering techniques to study defects in solids. Low-temperature thermal conductivity measurements were made on Sn, Sn–Cd, sapphire, tourmaline, and fluorapatite in the range

4 to 77°K. Work is described on improved techniques of generating surface waves and of measuring surface wave attenuation. Waves were generated using wedges and interdigital transducers on removable plaques. Attenuation changes were measured using insertion loss changes, and absolute values of attenuation were obtained by proving the beam using optical diffraction. Measurements were made on surfaces with bonded powder, and on quartz surfaces subject to particle irradiation. In the latter case the effect of irradiation was too small to be measured. Theoretical studies include radiative heat transport in solid composites and thermoelectric power of metals. (auth)

27496 (KFK-1963) CREEP BEHAVIOR OF TWO AUSTENITIC STAINLESS STEELS UNDER INCREASING LOAD. Schaefer, L.; Closs, K. D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Apr 1974. 34p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

Creep tests under linear increasing stress have been performed on unirradiated tubular specimens under uniaxial and biaxial stress conditions (steel No. 1.4981) and on unirradiated and irradiated sheet tensile specimens (steel No. 1.4970). Three methods have been evaluated for describing the creep curves under increasing stress. The three methods are: a graphic representation, an analysis of the creep rate as a function of stress and stress rate, and the application of the time-fraction rule for creep strength curves. The different methods give similar results. The advantages and disadvantages of the three methods are discussed. (auth)

27497 (LA-5660-PR) ADVANCED PLUTONIUM FUELS PROGRAM. Quarterly Report, January 1–March 31, 1974. Baker, R. D. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1974. Contract W-7405-eng-36. 32p. Dep. NTIS $4.00.

Progress in the development and testing of LMFBR fuels is reported. (DG)

27498 EFFECT OF NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES AND ON THE EFFECT OF PROGRAMMED LOADING OF TITANIUM. Gindin, I. A.; Lapiashvili, E. S.; Naskidashvili, I. A.; Neklyudov, I. M. (Inst. of Physics, Tbilishi, USSR). Strength Mater. (USSR) (Engl. Transl.); 5: No. 8, 952-955(Aug 1973).

Translated from Probl. Prochnosti; 5: No. 8, 49-52(Aug 1973).

Results of investigation on effects of neutron irradiation and subsequent thermal and mechanical treatments on Ti are presented. Results show that neutron irradiation causes marked changes in strength, increased yield stress, decreased rate of hardening in the plastic range, and lowered relative elongation. (JRD)

27499 MIGRATION OF Mo ATOMS ACROSS Mo–Si INTERFACE INDUCED BY Ar^+ ION BOMBARDMENT. Nishi, H.; Sakurai, T.; Akamatsu, T.; Furuya, T. (Fujitsu Laboratories Limited, Kamikodanaka, Kawasaki, Japan). Appl. Phys. Lett. 25: No. 6, 337-339 (15 Sept 1974).

Backscattering analysis is used to investigate the effect of 150–keV Ar ion bombardment on Mo thin films evaporated on silicon. Ar ion bombardment induces the migration of Mo atoms into the underlying substrate. These migration phenomena are caused mainly by an atomic recoil process, and depend on implanted ion dose and on film thickness. These phenomena are also affected by the peculiarity of the Mo–Si interface. The migration of Mo atoms occurs most noticeably at a thickness of 450 ± 50 A, where about five Mo atoms for every incident Ar ion are introduced. (auth)

27500 PROCEEDINGS OF THE THIRTY-FIRST ANNUAL MEETING OF THE ELECTRON MICROSCOPY SOCIETY OF AMERICA, NEW ORLEANS, LOUISIANA, AUGUST 14–17, 1973. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Division (1973). 731p. (CONF-730816-).

Over 350 extended abstracts are presented on many aspects of high voltage electron microscopy. Included is information on thin films; fibers and polymers; solid surfaces and interfaces; surface analysis; metals and alloys; geological specimens; resolution and contrast; and biological microscopy. Twenty-three papers were selected for inclusion in Nuclear Science Abstracts. (SFL)

For abstracts of individual papers see: 27013, 27352, 27385, 27386, 27395, 27396, 27442–27449, 27501–27504, 27555–27558, and 28588.

27501 APPLICATION OF HVEM TO THE STUDY OF RADIATION DAMAGE IN METALS. Laidler, J. J.; Mastel, B. (Westinghouse Hanford Co., Richland, WA). pp 10-11 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

Use of high voltage electron microscopes (HVEM) for continuous observation of crystal defect accumulation in metals during irradiation is described. A particular application of HVEM for simulation of neutron irradiation effects in stainless steel is discussed. Stereomicrographs are included showing simulation of neutron irradiation effects in 316 stainless steel by means of 1 MeV electron irradiation. (JRD)

27502 VOID COARSENING DURING IRRADIATION OF STAINLESS STEEL. Laidler, J. J.; Mastel, B. (Westinghouse Hanford Co., Richland, WA). pp 12-13 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

A high voltage electron microscope was used to produce high equivalent neutron fluences by irradiation of 316 stainless steel using 1-MeV electrons. Stereomicrographs were made at regular fluence increments for use in determining the nature and extent of void coarsening reactions. Results of the study show that void coalescence is the primary mechanism for void coarsening at high fluences, and that the contribution due to Ostwald ripening is insignificant, provided that boundary layer effects are taken into account. In the presence of internal sinks such as grain boundaries, however, this mechanism could become important. (JRD)

27503 LOOP AND VOID FORMATION IN COPPER DURING HIGH VOLTAGE ELECTRON MICROSCOPE IRRADIATION. Kenik, E. A.; Mitchell, T. E. (Case Western Reserve Univ., Cleveland). pp 22-23 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

The effect of foil thickness on void formation during high voltage electron microscope (HVEM) irradiation has been studied in 4N5 copper. Irradiations were performed in a Hitachi 650B HVEM operated at 650 kV at 1.5 displacements/atom/s (DPA) for periods of 1 to 8 h. The formation of dislocation loops at 200°C in a thin foil (4000 Å) is shown in micrographs. The dislocation density passes through a maximum as a function of irradiation time, followed by extensive loop unfaulting and slippage from the foil. There seem to be insufficient dislocations to support void formation. After irradiation for eight hours, no voids were observed in this foil. There are several techniques which allow voids to be generated in foils of this thickness. All are directed at increased retention of dislocations in the foil. The initial presence of dislocations slows loop growth and provides barriers to loop escape. A higher dislocation density is retained and sufficient biased sinks are present to allow void formation. In thicker foils of undeformed copper (5000 Å), sufficient dislocations are retained strictly from irradiation to permit void nucleation and growth to occur at 200°C. (auth)

27504 NEUTRON RADIATION DAMAGE IN Zr–2.5 wt % Nb ALLOYS. Faulkner, D. (Atomic Energy of Canada Ltd., Whiteshell); Styles, R. C. pp 152-153 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

Results of irradiation of disks of the alloy to 1.24×10^{21} N cm^- (E > 1 MeV) are described. Structural changes are shown in micrographs. (JRD)

27505 ANGULAR DISTRIBUTION OF COPPER ATOMS SPUTTERED WITH ENERGETIC IONS. Roedelsperger, K.; Krueger, W.; Scharmann, A. (Giessen Univ. (F. R. Germany). 1. Physikalisches Inst.). Z. Phys.; 269: No. 1, 83-88(1974).

7 figs., 17 refs.

Measurements of the angular distribution of copper atoms which are sputtered by noble gas ions within the energy range between 0.1 and 1 MeV have been carried out for different angles of ion incidence. The hemisphere over the target surface could be studied with a microphotometer inside the sputtering chamber and the distributions can be plotted in tri-dimensional diagrams. The results are in principle similar to those obtained at lower energies. The angle of maximum emission varies with ion energy and with the angle of incidence and can be related to the sputtering yield. (auth)

27506 DEFORMATION OF BERYLLIUM MONOCRYSTALS BY LASER RADIATION. Papirov, I. I.; Avotin, S. S.; Krivchikova, E. P. Fiz. Khim. Obrab. Mater.; No. 3, 18-21(1974). (In Russian).

Metallographic studies were made of the structure of beryllium monocrystals with (0001) and (11$\bar{2}$0) after irradiation with a pulsed lasers at 77, 300, and 580°K. The nature of the plastic deformation close to the crater depended on the temperature of the irradiated crystals and differed from the deformation under static conditions. The width of the deformation zone increased with increase in temperature with simultaneous decrease in the contributing of twinning. Movement of the twinning boundaries was eased with increas in temperature, on the basis of which conclusions concerning the thermo-activation nature of this process were drawn. Cross-slipping of dislocations 1/3 ⟨11$\bar{2}$0⟩ at 77°C was observed. (tr-auth)

27507 INTERSTITIAL CLUSTERS IN ELECTRON IRRADIATED ALUMINUM. Kiritani, M.; Yoshida, N.; Takata, H. (Osaka Univ., Toyonaka, Japan). J. Phys. Soc. Jap.; 36: No. 3, 720-729(Mar 1974).

Variation of the image position of the loop dislocation with the change in diffraction condition indicates that the dislocation loops formed in aluminum by electron irradiation in a high voltage electron microscope at room temperature or above may be identified to be of interstitial type. This result is confirmed by comparison of the weak and strong contrast from the stacking fault of irradiation induced loops with that of quench induced vacancy type dislocation loops. Quench induced vacancy type dislocation loops shrink and disappear by electron irradiation, and their absorption of interstitial atoms suppresses the formation of irradiation induced interstitial type loops. The upper limit of temperature for loop formation depends on irradiation intensity, and is about 160°C for 2×10^{19} electrons/cm^2 · s at 1000 kV. Enhanced formation of interstitial loops is observed on both intrinsic and extrinsic stacking faults which suggests the existence of attractive interaction between the fault and interstitial atoms. (JA)

27508 ANNEALING OF DEFECTS FORMED IN GERMANIUM AFTER IRRADIATIONS WITH PARTICLES OF VARIOUS ENERGIES. Fukuoka, N.; Saito, H.; Tatsumi, Y. (Osaka Univ., Toyonaka, Japan). J. Phys. Soc. Jap.; 36: No. 3, 793-799(Mar 1974).

Isochronal annealing of the defect induced in germanium by electrons at 10, 5, or 1.5 MeV or fast neutrons was studied. For the case of crystals irradiated with 10 MeV or 5 MeV electrons, an annealing stage was observed in the range 180 to 240°K. The stage was observed in all specimens doped with antimony, arsenic, or phosphorus after irradiation with 10 MeV electrons, but it was not observed for crystals irradiated with 1.5 MeV electrons. These behaviors are discussed and it is concluded that the defect which anneals in the stage is considered to be a stable vacancy-interstitial pair. Considering the fact that the annealing in the range 260 to 480°K is independent of irradiating energies, the induced defects by 10 MeV electron irradiation are of the same kind as those induced by 1.5 MeV electron irradiation except for the stable vacancy-interstitial pair which anneals near 200°K. (JA)

27509 STABILITY OF VOIDS IN MATERIALS UNDER IRRADIATION. Norris, D. I. R. (Berkeley Nuclear Labs., Eng.); Brown, L. M. Scr. Met.; 8: No. 9, 1045-1048(Sep 1974).

The suggestion was examined that an equilibrium array of voids in a crystal could be a general effect during irradiation, thus providing a mechanism to limit swelling due to voids. A model of this concept is formulated to include mutual recombination of interstitials with vacancies, dislocations acting as point defect sinks, and concentration of vacancies due to thermal equilibrium. (JRD)

27510 RADIATION-ENHANCED PRECIPITATION IN Al–4% Cu BY HIGH VOLTAGE ELECTRON MICROSCOPY. Sklad, P. S.; Mitchell, T. E. (Case Western Reserve Univ., Cleveland). Scr. Met.; 8: No. 9, 1113-1118(Sep 1974).

Results of experiments on the effects of electron irradiation on precipitation in Al–4 wt % Cu are presented. In all cases investigated the kinetics of θ' precipitation observed in specimens irradiated during aging are more rapid than those seen in non-irradiated specimens. In addition, the enhancement in the precipitation process is greater at high fluxes. Electron irradiation also inhibits the formation of the metastable θ'' precipitate. These results are discussed in terms of the effect of irradiation produced defects on nucleation or diffusion kinetics. (auth)

27511 EFFECT OF THERMAL ANNEALING AND ION RADIATION ON THE COERCIVITY OF AMORPHOUS Gd–Co FILMS. Hasegawa, R.; Gambino, R.J.; Cuomo, J.J.; Ziegler, J.F. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). J. Appl. Phys. 45: No. 9, 4036-4040 (Sept 1974).

Ferrimagnetic amorphous Gd–Co films deposited by rf sputtering with uniaxial perpendicular anisotropy were annealed at about 200 °C with or without a magnetic field of 3 kOe applied perpendicularly to the film plane. Data taken using the polar Kerr magneto–optic effect show a significant decrease in the value of the wall–motion coercivity H_c. A reduction of H_c by an order of magnitude was generally attained in films having compositions in the vicinity of the magnetic compensation point. Similar results were obtained in a film irradiated with 2.5–MeV argon ions. These data are discussed in terms of fluctuations in various parameters contributing to the resultant coercivity. The results indicate that the fluctuations in the exchange stiffness constant dominate over the others and, consequently, are most affected by the postdeposition treatments. The results for the ion–irradiated film suggest that the origin of the uniaxial anisotropy is due to pair ordering of Co atoms. (auth)

27512 TEMPERATURE AND TIME DEPENDENCE OF DISLOCATION PINNING–POINT DENSITY IN FAST–NEUTRON–IRRADIATED COPPER CRYSTALS. Paré, V.K.; Guberman, H.D.; DeNee, P.B. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). J. Appl. Phys. 45: No. 4, 1615-1625 (Apr 1974).

The effects of fast–neutron–induced defects on the dislocation internal friction and modulus defect of copper crystals were studied by two procedures: (i) irradiation at 20 °K followed by measurements during heating at a constant rate to room temperature and (ii) measurements during and after irradiations at various constant temperatures between 90 and 410 °K. The measurements were made at low enough strain amplitude so that breakaway of dislocations from pinning points did not occur. Samples of known dislocation density were used in many of the experiments so that the "vibrating–string" model of dislocation motion could be used to calculate approximate absolute values for the densities of radiation–defect pinning points obtained at various temperatures. These were characterized by the ratio g of pinning points collected to freely migrating radiation defects created in the samples, assuming that on the average 20 defects can migrate away from the cascade region of each primary recoil. For the lower–temperature pinning processes which showed no time delay, values of g increased monotonically from 10^{-6}–10^{-5} at 60 °K to 10^{-4}–10^{-3} at 204 °K. The higher–temperature process is known to have a broad delay–time distribution; by collecting all pinning points available at 410 °K a g value of ~0.1 was obtained. Because of uncertainty as to the validity of the vibrating–string model, pinning–point densities were obtained primarily from the modulus–defect data. The damping data often implied the same densities but sometimes disagreed seriously with the modulus–defect results. (auth)

27513 APPLICATIONS OF ION BEAMS TO METALS. International Conference Held in Albuquerque, New Mexico, October 2–4, 1973. Picraux, S. T.; EerNisse, E. P.; Vook, F. L. (eds.). New York; Plenum Publishing Corporation (1974). 717p. (CONF-731028-). $39.50.

Fifty-three papers presented at the conference are included in the book. A separate abstract was prepared for each of twenty-five papers. Papers for which no abstracts were prepared are concerned with ion induced surface reactions, thin films and interfaces, alloying and migration in high fluence implants, implanted atom location, and ion lattice damage. (JRD)

For abstracts of individual papers see: 27373, 27514–27532, and 28371–28375.

27514 ION DAMAGE EFFECTS IN METALS AS STUDIED BY TRANSMISSION ELECTRON MICROSCOPY. Wilkens, M. (Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 441-458 of Application of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

The application of transmission electron microscopy (TEM) to the study of radiation damage in metals due to ion bombardment is described. A brief review of methods used for diffraction contrast analysis of small point defect clusters is given. The application of these methods to the TEM study of ion damage is discussed. Special emphasis is given to the analysis of point defect clusters produced by displacement cascades. (auth)

27515 TRANSMISSION ELECTRON MICROSCOPY STUDY OF IMPLANTATION INDUCED DEFECTS IN GOLD. Ruault, M. O. (CNRS, Toulouse); Jouffrey, B.; Chaumont, J.; Bernas, H. pp 459-467 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

Results are presented of experiments conducted to compare experimental defect depth distribution with predicted distribution and to characterize the defects. Implantation of Yb, Mo, Xe, Kr, Ar, and Fe ions was carried out in the Orsay ion-implantation facility. The results are given in graphs, tables, and micrographs and discussed. (JRD)

27516 TRANSMISSION ELECTRON MICROSCOPE STUDIES OF DEFECT CLUSTERS IN ALUMINUM IRRADIATED WITH GOLD IONS. Gomez-Giraldez, C.; Hertel, B.; Ruehle, M.; Wilkens, M. (Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 469-480 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

Aluminum foils are irradiated with gold ions at 20, 40, and 70 keV. The damage structure is studied using an electron microscope. Small defect clusters can be analyzed. The number density of the defect clusters increases linearly with the dose with a yield factor of 0.21 after 70 keV irradiation. The defects are analyzed as Frank dislocation loops ($b = \frac{1}{3}\langle 111\rangle$) of vacancy type. The loops are formed by a collapse of the vacancy rich region in the rather small cascade. Small spherical defects previously observed in Au and Cu are missed in the experiments. This could be caused by the presence of the 50 Å thick Al_2O_3 layer on the electropolished aluminum. The unexpected high clustering efficiency is discussed. The value could be explained by the assumption that during irradiation at room temperature, interstitials escape with a high probability from the vacancy rich region of the cascade. (auth)

27517 DECHANNELING FROM DAMAGE CLUSTERS IN HEAVY ION IRRADIATED GOLD. Pronko, P. P.; Merkle, K. L. (Argonne National Lab., IL). pp 481-494 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

Results of experiments to determine variations in helium ion dechanneling cross sections and cascade volumes as function of incident Au ion energy are presented. The results indicate that dechanneling of light particle beams is an effective way of studying heavy ion damage clusters in metals. The experimental dechanneling cross sections confirm that defect clusters, observable as black-spots in the electron microscope, are responsible for dechanneling in the fluence range up to 5×10^{12} ions/cm^2. Analysis of the saturation damage behavior yields dimensions for the collision cascades that are consistent with the random cascade model. The cluster dechanneling cross section for protons at 270 keV is consistently lower than for $^4He^+$ at the same energy for all fluences studied. In the linear damage-fluence region the $^4He^+$ dechanneling cross section is higher than for protons suggesting a $\sqrt{Z}$ dependence. This suggests that the nature and the strength of the charged particle collision dominates over critical angle considerations in cluster dechanneling. (auth)

27518 HEAVY ION DAMAGE IN THIN METAL FILMS. Kesternich, W.; Merkle, K. L. (Argonne National Lab., IL). pp 495-505 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

Electric conductivity measurements were used to study monoenergetic displacement cascades in Au, Ag, and Cu. The damage rate vs. induced resistivity curves for Cu, Ag, and Au show an initially strong decrease in the damage rate. Damage production efficiencies in displacement cascades in Au, Ag, and Cu based on resistivity change are given. The cascade volume increases from Au to Ag and Cu and the damage volume is in general smaller than the total cascade volume. The average Frenkel pair concentrations are on the order of 10^{-4}. The average energy per atom is <.1 eV. Thermal spike effects could play a role in Au and Ag, but not in Cu. (auth)

27519 FORMATION OF INTERSTITIAL AGGLOMERATES AND GAS BUBBLES IN CUBIC METALS IRRADIATED WITH 5 keV ARGON IONS. Hertel, B.; Diehl, J.; Gotthardt, R.; Sultze, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 507-520 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

Results of Ar ion bombardment of Cu, Au, and Nb disks are presented. Data on depth distributions of gas bubbles and interstitial defect agglomerates in these metals are presented in graphs and analyzed. (JRD)

27520 OBSERVATION OF ION BOMBARDMENT DAMAGE IN A Ni(100) CRYSTAL BY HELIUM ION INJECTION. Kornelsen, E. V.; Edwards, D. E. Jr. (National Research Council, Ottawa). pp 521-529 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

Helium entrapment in Ni bombarded by helium and heavier ions was studied. It was found that helium atoms migrate freely as interstitials in nickel at room temperature but become trapped if they encounter defects containing one or more lattice vacancies. On the basis of desorption spectra obtained while varying helium ion energy and dose and damage annealing temperature, it has been possible to assign some of the observed desorption peaks tentatively to specific trap configurations. Regardless of the accuracy of the assignments made the results clearly demonstrate, as in the case of tungsten, that helium trapping in nickel is very sensitive to the presence of ion-induced lattice damage and that the helium binding energy is highly specific to the detailed atomic configuration of the trap. (auth)

27521 HELIUM IMPLANTATION EFFECTS IN VANADIUM AND NIOBIUM. Thomas, G. J.; Bauer, W. (Sandia Labs., Livermore, CA). pp 533-542 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

The effects of high-fluence 300-keV He implantation in Nb and V at 400 to 1200°C were examined. Results show a slow bubble growth and a high bubble density (nucleation probability). The strong trapping prevents release of implanted gas, however, and an interconnected gas filled region is ultimately formed. It is not known whether this occurs by actual bubble overlap during growth or if there is some critical spacing at which individual bubbles interact. At the intermediate temperature region of 800 to 900°C, vacancies are highly mobile allowing the formation of much larger bubbles which are in equilibrium with the lattice, and therefore, generating considerably less lattice strain. The large volume increase due to the bubbles produces a macroscopic swelling of the implanted region. At the highest temperatures studied (1000 to 1200°C) the high mobility of gas, vacancies, and presumably small bubbles produces very large bubbles which continue to grow until they eventually intersect the surface. The resultant porous structure allows the rapid release of implanted He so that the re-emission value is high and further bubble growth is inhibited. (auth)

27522 EFFECT OF He^+ AND D^+ ION BEAM FLUX ON BLISTER FORMATION IN NIOBIUM AND VANADIUM. Das, S. K.; Kaminsky, M. (Argonne National Lab., IL). pp 543-555 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

The effect of incident ion beam flux on the blister formation in annealed polycrystalline niobium and vanadium has been investigated for 0.5-MeV He^+ and 0.25-MeV D^+ projectiles. For the He^+ ions the flux was varied from 1×10^{13} ions/(cm^2-s) to 1×10^{15} ions/(cm^2-s), the targets were held at 900°C, and the total dose was varied from 0.1 to 1.0 C/cm^2. For the D^+ ion irradiation the flux was varied from 1×10^{14} to 1×10^{15} ions/(cm^2-s), the niobium targets were held at 700°C, and the total dose was 2.0 C/cm^2. For both the helium implanted vanadium and niobium the blister density shows a stronger flux dependence than the average blister diameter. For deuteron implanted niobium the blister size increased as the flux was increased from 1×10^{14} to 1×10^{15} ions/(cm^2-s). (auth)

27523 DEPTH DISTRIBUTION AND MIGRATION OF IMPLANTED HELIUM IN METAL FOILS USING PROTON BACKSCATTERING. Blewer, R. S. (Sandia Labs., Albuquerque, NM). pp 557-572 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

Proton backscattering at 2.5 MeV has been used to measure the mean depth and profile of implanted helium distributions as a function of implant energy, implant fluence, and post-implant anneal temperature in copper foils of varying thickness. Distributions implanted at 54, 104, and 158 keV agree (to within 100 Å) with calculated projected ranges for helium in copper at each energy. At room temperature the shape of the distributions is approximately Gaussian with no evidence of a supertail or of the peaks being skewed either toward the surface or the interior of the foils. Implantation of some foils was performed at two energies (highest energy first) using both equal and unequal doses. Resultant profiles were those expected from overlapping Gaussians centered at the predicted depths. Implanted helium fluences ranging from

5×10^{16} to 3×10^{17} He^+/cm^2 result in backscattering peaks for helium which increase in magnitude in the proper proportion to increasing fluence. Detection sensitivity of 1 at. % He in Cu has been demonstrated. In addition, profiling of other low Z elements (e.g. oxygen, carbon, and deuterium) in the foils or on their surfaces is also described. (auth)

27524 BLISTERING OF NIOBIUM DUE TO LOW ENERGY HELIUM ION BOMBARDMENT INVESTIGATED BY RUTHERFORD BACKSCATTERING. Roth, J.; Behrisch, R.; Scherzer, B. M. U. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 573-584 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

Radiation damage and blister formation in a Nb single crystal due to room temperature bombardment with 2 to 4 keV He^+ ions has been investigated by Rutherford backscattering in double aligned technique (⟨100⟩/⟨111⟩ and ⟨111⟩/⟨111⟩) of 150 keV protons. By this technique it is possible to observe in situ the development of blisters. The critical ion dose for blister formation is about 10^{17} He^+/cm^2 increasing with energy. It is higher for He^+ bombardment in aligned than in random directions. The mean thickness of the cover of the blisters increases from 234 Å at 2 keV to 420 Å at 4 keV He^+ bombardment in random direction. The average blister size as measured by the SEM was 600 Å at 2 keV and 1400 Å at 4 keV random bombardment. In ⟨100⟩ aligned bombardment it increases by roughly a factor of 2. The results of backscattering measurements before the appearance of blisters may be interpreted by the assumption that small helium bubbles are formed at the penetration depth of the He ions. The measured penetration depth is considerably larger than predicted by theory (Schiøtt). (auth)

27525 RADIATION DAMAGE AND GAS DIFFUSION IN MOLYBDENUM UNDER DEUTERON BOMBARDMENT. McCracken, G. M.; Erents, S. K. (Culham Lab., Abingdon, Eng.). pp 585-596 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

The diffusion of hydrogen in metals is critically dependent on the amount of damage in the lattice. The effective solubility of hydrogen is similarly affected. In molybdenum the effects are particularly of importance at temperatures below 750°K. Measurements have been made of the rate of defect production by incident ions of a type of trapping site with a binding energy above a certain critical value. This value is determined by the temperature at which the experiment is carried out; a wide range of temperatures should be investigated in the future. These results show that hydrogen implantation is a potentially valuable tool for measuring defect concentrations although the interpretation of the types of defect detected has not yet been made. The technique should be equally applicable to damage produced by radiation rather than ions, e.g., to electrons and neutrons. (auth)

27526 RADIATION BLISTERING AFTER H^+, D^+, AND He^+ ION IMPLANTATION INTO SURFACES OF STAINLESS STEEL, Mo, AND Be. Verbeck, H.; Eckstein, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 597-610 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

H^+, D^+, and He^+ ions with energies of 15 and 150 keV were implanted into surfaces of stainless steel, Mo, and Be. The occurrence of blisters was observed by scanning electron microscopy and by optical interference microscopy. In all investigated metals severe blistering was observed after He irradiation to fluences above 3×10^{17} ions/cm². On H^+ and D^+ bombarded stainless steel irregular shaped blisters were observed mainly at special sites such as grain boundaries and precipitations. The critical fluence for blister formation by 15 keV D^+ ions was in the order of 5×10^{18}/cm². For polycrystalline Mo the shape and the average size of hydrogen blisters depends strongly on the pretreatment of the targets. For annealed targets the blister size is much smaller than for unannealed material. The shape and the critical fluence depend strongly on the orientation of individual grains. The critical fluence, defined as the value at which blisters are first observed in some grains, decreases with increasing current density of the bombarding particles. On D^+ bombarded Be, blisters occurred at fluences below $3 \cdot 10^{17}$ ions/cm². (auth)

27527 REVIEW OF ION SIMULATION OF HIGH TEMPERATURE NEUTRON DAMAGE AND VOID FORMATION. Kulcinski, G. L. (Univ. of Wisconsin, Madison). pp 613-637 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

It has been shown that in the short period of four years the ion bombardment simulation technique has made notable discoveries about the formation of voids in metals. The simulation study results are now giving a preview of what to expect after long term high temperature neutron bombardment; it is a quick, easy, and economical tool to screen new alloys. Future work of a basic nature will undoubtedly contribute to void nucleation and growth theories. It is possible that the simulation technique will be even more valuable to the controlled thermonuclear reactor program than it has been to the LMFBR program. (auth)

27528 ION RADIATION DAMAGE. Oen, O. S.; Narayan, J.; Noggle, T. S. (Oak Ridge National Lab., TN). pp 639-650 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

The depth distribution of damage energy deposited in solids by energetic ions has been calculated and results are compared with the experimental damage found in copper which has been irradiated with 10^{16} 1-MeV protons at ambient temperature. The general form of the experimental damage profile from the transmission electron microscope measurements agrees well with that calculated. (auth)

27529 4-MeV IRON ATOM BOMBARDMENT OF IRON. Beeler, J. R. Jr.; Beeler, M. F. (North Carolina State Univ., Raleigh). pp 651-662 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

The study was conducted using computer methods. Entire 4-MeV collision cascades were simulated by computing in sequence, each atom–atom collision in each cascade on an individual basis. Results show that in MeV-energy atom bombardment, many of the cascades produced by high-energy primary kinetic atom (PKA) can interact during short-term annealing. These atoms are usually produced in the final $\frac{1}{3}$ of the primary range. This circumstance gives rise to a type of short-term annealing environment not found in other types of primary particle irradiation. One consequence of this is the formation of interstitial dislocation loops at an earlier time than would be the case were there no interaction among cascades during annealing. (JRD)

27530 FLUX (DOSE RATE) EFFECTS FOR 2.8 MeV ^{58}Ni IRRADIATIONS OF PURE Ni. Westmoreland, J. E.; Sprague, F. A.; Smidt, F. A.; Malmberg, P. R. (Naval Research Lab., Washington, DC). pp 663-674 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

An experiment was conducted to obtain two quantitative curves of swelling versus irradiation temperature in pure Ni in which the dose rate is the only variable. The effects of a factor of 100 in dose rate on the final observed damage microstructure for the case for all other irradiation parameters remaining the same were assessed. Adequate agreement was not obtained in comparison with two of the theoretical predictions of the effect of flux on swelling. The implication of this is not at present clear. (auth)

27531 HEAVY ION-INDUCED VOID FORMATION IN PURE NICKEL. Ryan, T. D. (Argonne National Lab., IL); Taylor, A. pp 675-685 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

The void structure in pure nickel induced by irradiation with $^{12}C^+$, $^{20}Ne^+$, $^{35}Cl^+$, and $^{58}Ni^+$ is being investigated as a function of temperature and dose using a dose rate of 2.5×10^{-3} displacements/atom/s at a preselected depth of 6700 Å. The dose dependence of swelling to 60 displacements/atom, and the temperature dependence at 10 displacements/atom between 500 and 700°C for self-ion irradiations, are in substantial agreement with previous studies. The peak swelling was observed in a 600°C irradiation in which the number density was 2×10^{15}/cm³, the mean size was 280 Å and the total volume fraction was 3%. As a function of tem-

perature, the mean void size increased by 2.5, and the number density decreased an order of magnitude. Preinjection of He did not influence the total swelling. Asymmetry in the thickness of the void-denuded layers across grain boundaries was directly correlated with grain-boundary motion during the irradiation. Preliminary data for $^{12}C^{+}$ irradiation at these temperatures indicates that the peak swelling temperature occurs at least 25°C lower than for self-ion irradiations. (auth)

27532 TEMPERATURE DEPENDENCE OF IRRADIATION INDUCED VOID SWELLING IN 20% COLD WORKED TYPE 316 STAINLESS STEEL IRRADIATED WITH 5-MeV NICKEL IONS. Challenger, K. D.; Lauritzen, T. (General Electric Co., San Jose, CA). pp 687-698 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

The temperature dependence of swelling for 20% cold worked Type 316 SS containing nominally 15 ppM He has been established using 5 MeV nickel ions; swelling was measured using standard transmission electron microscopy techniques. The damage rate in this experiment is higher than in fast reactor irradiation resulting in a shift in the peak swelling temperature of +115 ± 25°C. Swelling is studied in the temperature range of 475 to 725°C after doses causing up to 105 displacements per atom. The technique is experimentally verified as a valid simulation of fast reactor irradiation for temperatures up to 625°C when the appropriate temperature shift is applied. Swelling in the cold worked steels is less than that previously reported for an annealed steel at all temperatures and doses studied. However, above 625°C thermal recovery of the cold work results in a swelling behavior that gradually approaches that of annealed steel as the temperature and dose are increased. Swelling occurs in the temperature range of 525 to ~725°C with a maximum swelling at 625°C for both annealed and cold worked steels. Void distributions in the cold worked steel become increasingly nonuniform as the irradiation temperature is increased; voids are distributed in bands following the original deformation substructure. Voids nucleate easier and grow faster in regions that have undergone recovery during irradiation. The lower swelling in the cold worked steels is brought about by a combination of reduced void size and number density. (auth)

Other Materials

Refer also to abstracts 26456, 26467, 27370, 27495, 28085, and 28111.

27533 (AD-773836) MULTIAXIAL RESPONSE OF ATJ-S GRAPHITE. Final Report, 1 July 1972–15 May 1973. Jortner, J. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). Oct 1973. Contract F33615-72-C-2047. 132p. (MDC-G-3581; AFML-TR-73-170). NTIS $4.75.

Experiments to explore the fracture and deformation of ATJ-S graphite under multiaxial stresses are described. The program included additional fracture tests in biaxial tension at 2000°F; an analytical evaluation of the applicability and limitations of biaxial test data; tests at room temperature under triaxial stress states to measure the effects of multiaxiality on strain; and some biaxial experiments at room temperature to further explore the nature of biaxial softening (the occurrence of unexpectedly large strains in biaxial tension). (GRA)

27534 (AD-774401) SURFACE TEMPERATURE MEASUREMENTS FOR ION BOMBARDED Si AND GaAs AT 1.0 TO 2.0 MeV. Lowe, L. F.; Kennedy, J. K.; Davies, D. E.; Deane, M. L.; Eyges, L. J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 29 Oct 1973. 11p. (AFCRL-PSRP-571; AFCRL-TR-73-660). NTIS $3.00.

The use of ion implantation both as a research tool and as an electronic device fabrication technique has increased significantly in recent years. One parameter of interest is the temperature produced by the bombarding ions in the implanted volume during the irradiation. An infrared detector was used to measure these temperatures for ion beams of N^{+}, N^{2+}, O^{+}, O^{2+}, C^{+}, CO^{+}, and H^{+} at energies from 1 to 2.0 MeV and currents up to 12 $\mu A/cm^2$. (auth)

27535 (AD-775371) RADIATION-INDUCED CHANGES IN EXPLOSIVE MATERIALS. Avrami, L.; Jackson, H. J.; Kirshenbaum, M. S. (Picatinny Arsenal, Dover, N. J. (USA)). Dec 1973. 81p. (PA-TR-4602). NTIS $4.00.

A group of eleven explosive materials in powder and pellet form were subjected to ^{60}Co gamma radiation. The explosives were studied using weight loss, dimensional change, vacuum stability, DTA, TGA, infrared spectra, melting point, impact sensitivity, explosion temperature, and rates of detonation as a function of total gamma exposure up to and including levels of ten to the ninth power R. Based on this work, a damage threshold as a function of total gamma dose was determined for each material. Results indicate that the capability of the explosives studied to withstand ^{60}Co gamma radiation decreases in the following order: TACOT = or > TATB = or > DATB = or > HMX = or > Tetryl = or > TNB = or > TNT = or > RDX = or > PETN > NGu > BaN_6. (auth)

27536 (AD-775389) STUDY OF THE EFFECTS OF RADIATION ON THE ELECTRICAL AND OPTICAL PROPERTIES OF HgCdTe. Colwell, J. F.; Green, B. A.; Leadon, R.; Mallon, C. E.; Naber, J. A. (Intelcom. Rad. Tech., San Diego, Calif. (USA)). 3 Dec 1973. Contract F19628-72-C-0311. 62p. (RT-8027-004; AFCRL-TR-73-0761). NTIS $3.75.

Results are given of experimental and theoretical investigation of the effects of electron irradiation on the electrical and optical properties of the alloy semiconductor HgCdTe. These results include measurements of the carrier concentration, Hall mobility, carrier lifetime, and photoconductive response for the preirradiation conditions, as a function of electron fluence and as a function of annealing temperature. The electron irradiations of these samples were performed at 80°K with 5-MeV electrons and at annealing temperatures up to 350°K. A model is developed to explain the changes in mobility, carrier concentration, and photoconductive response. (GRA)

27537 (AED-CONF-73-407-030) THE VAPOR PRESSURE OF PROTACTINIUM(V)-BROMIDE. Weigel, F.; Brown, D.; Hoffmann, G.; Wishnevsky, V. (Muenchen Univ. (F. R. Germany). Inst. fuer Anorganische Chemie). 1973. 7p. INIS.

From 24th congress of the International Union of Pure and Applied Chemistry; Hamburg, F. R. Germany (2 Sep 1973).

5 figs.; 2 tabs.; 7 refs.

The vapor pressure of protactinium(V) bromide was measured using an all-silica membrane gage. Below the melting point, the vapor pressure is represented by an equation different from that above the melting point. The extrapolated boiling point was found to be 701°K (428°C). Thermodynamic parameters were calculated from the experimental data. (GE)

27538 (AED-CONF-74-089-008) CONVERSION OF O-H_2 TO P-H_2 BY NEUTRON SCATTERING IN SOLID O-HYDROGEN. Diehl, H. W.; Biem, W. (Giessen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). 1974. 6p. (CONF-740451-2). (In German). INIS.

From spring meeting of the Arbeitskreis Festkoerperphysik of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

8 figs. With abstract.

Slow neutrons in solid o-hydrogen can change a molecule into p-hydrogen during the scattering process, and synchronously generate phonons and librons. The cross-section for these processes is calculated. A method is developed which principally enables the crystal to be described at any composition. (GE)

27539 (AED-CONF-74-089-044) THERMAL CONDUCTIVITY OF GAMMA IRRADIATED LiF. Guckelsberger, K.; Neumaier, K. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Basses Temperatures; Bayerische Akademie der Wissenschaften, Muenchen (F. R. Germany). Zentralinstitut fuer Tieftemperaturforschung). 1974. 7p. (CONF-740451-3). (In German). INIS.

From spring meeting of the Arbeitskreis Festkoerperphysik of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

6 figs.; 10 refs. With abstract.

The thermal conductivity of pure, monocrystalline γ-irradiated LiF was measured in the temperature range of 0.3 to 100°K. The F centers produced by the irradiation scatter the phonons like point defects; the appertaining fluorine atoms appear as aggregates of about 10 A in diameter a interstitial positions. Extensite distorted zones occur with high irradiation doses (>10^6 R). Each of these three defects influences the heat conduction in a characteristic temperature region and can thus be analyzed during the irradiation and subsequent healing. (GE)

27540 (COM-774159) RADIATION EFFECTS RESEARCH PROGRAM. Final Report, 1 September 1967–31 August 1973. Grannemann, W. W.; Boatwright, L. T.; Byatt, W. J.; Colclaser, R. A.; Southward, H. D. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Oct 1973. Contract N00014-68-A-0158. 76p. NTIS $4.00.

Radiation effects research was directed toward basic research objectives involving dielectric materials and semiconductor ma-

terials. Processing of dielectric materials and semiconductor materials was related to radiation effects. Secondary objectives included radiation effects on solid-state devices and circuits. (GRA)

27541 (COO-3584-3) NUCLEAR MAGNETIC RESONANCE STUDY OF THE GAS-LIQUID CRITICAL POINT IN HYDROGEN AND ITS ISOTOPIC MODIFICATIONS. Final Report, May 1, 1968-February 28, 1974. Lipsicas, M. (Yeshiva Univ., New York (USA). Belfer Graduate School of Science). 1974. Contract AT(11-1)-3584. 14p. Dep. NTIS $4.00.

A facility was constructed for NMR measurements of spin-lattice relaxation times and self-diffusion coefficients in hydrogen and its isotopic modifications in the critical region. NMR measurements of spin-lattice relaxation time T_1 and self-diffusion D_1 were made using separate coils for the liquid and gas phases above and below the sample cell. Preliminary measurements of T_1 were made on samples of normal hydrogen, excluding the temperature range very close to the critical point. (DLC)

27542 (ORNL-TM-4551) EFFECTS OF NEUTRON IRRADIATION ON LOOSE AND BONDED INERT PARTICLES COATED WITH PYROLYTIC CARBON AND SILICON CARBIDE. Hewette, D. M. II; Fitts, R. B.; Pollock, C. B.; Federer, J. I.; Scott, J. L. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 46p. Dep. NTIS $5.45.

The effect of fast neutron irradiation (>0.18 MeV) on coated particles was investigated in HFIR (1) to characterize in inert particles with Triso coatings the interaction between pyrolytic carbon (PyC) and silicon carbide (SiC) layers caused by fast neutron-induced densification of the PyC layers, and (2) to study the effects of irradiation on intrusion-bonded rods made from Triso-coated inert particles with various densities in the outer layer. The following irradiations were conducted: loose particles consisting of carbon kernels with Triso coatings were irradiated to peak fluences up to 11.7×10^{21} n/cm^2 at 750°C and up to 14.1×10^{21} n/cm^2 at 1050°C, and similar particles were irradiated in bonded rods to peak fluences of 9.5×10^{21} n/cm^2 at 750 and 1050°C. Densification of the PyC layers in both loose and bonded particles was greatest for originally low-density coatings and increased with temperature. Densification generally occurred up to an exposure of approximately 9×10^{21} n/cm^2, and was followed by swelling at higher exposure. Loose particles with inert kernels did not fail under any irradiation conditions, nor was there any marked separation of the PyC inner layer from the adjacent SiC layer. Thus, under the conditions of these experiments, the PyC density did not appear to be a strong factor affecting performance of loose particles. Coated inert particles in bonded rods performed well except those having very low-density PyC layers. The dimensional stability of bonded rods was related to the dimensional stability of the outer PyC coatings on the close-packed particles in the rod. The rods with the least dense particle coatings (~1.7 g/cm^3) shrank the most, and many particles failed. Failure of these particles was probably caused by stresses arising from a combination of matrix restraint and shrinkage of both the matrix and the coatings. (18 figures, 9 tables) (auth)

27543 LARGE REFRACTIVE INDEX CHANGE INDUCED BY ION IMPLANTATION IN LITHIUM NIOBATE. Wei, D.T.Y. (Rand Corporation, Santa Monica, California 90406); Lee, W.W.; Bloom, L.R. Appl. Phys. Lett. 25: No. 6, 329-331 (15 Sept 1974).

Large but negative refractive index change (~10% at 632.8-nm line) is observed in several lithium niobate samples, each occurring in a thin layer induced by implantation of argon or neon ions. Implantation energy is 60 kV and the ion dose is 10^{16} cm^{-2} or more in each sample. Mechanisms causing the refractive index change and possible applications for integrated optics are discussed. (auth)

27544 EPR OBSERVATION OF CLOSE FRENKEL PAIRS IN IRRADIATED ZnSe. Watkins, G.D. (General Electric Corporate Research and Development, Schenectady, New York 12301). Phys. Rev. Lett. 33: No. 4, 223-225 (22 July 1974).

Four distinct EPR spectra observed in ZnSe irradiated by 1.5-MeV electrons at 20.4 °K are identified as simple zinc-vacancy, zinc-interstitial close pairs of different microscopic configuration. Correlation of defect alignment with incident-electron-beam direction confirms the identification. Isolated zinc vacancies are also produced but with zero initial production rate, suggesting that their production is a two-step process, the first being the formation of close pairs. (auth)

27545 INFLUENCE OF DISORDERED REGIONS ON THE RECOMBINATION IN PROTON-IRRADIATED p-TYPE SILICON. Azimov, K.S.; Gorodetskii, S.M.; Grigor'eva, G.M.; Kreinin, L.B.; Landsman, A.P. Sov. Phys.-Semicond. 7: No. 8, 1021-1025 (Feb 1974).

An experimental study was made of the dependence of the damage of silicon solar cells and of p-type silicon on the proton energy in the 0.4-200 MeV range. The damage was represented by a coefficient K related to the change in the minority-carrier diffusion length L_n. Neither the value nor the energy dependence of K was in agreement with calculations carried out on the assumption that only proton-generated point defects participated in carrier recombination. A quantitative agreement between the theory and experiment was obtained when allowance was made for the influence of disordered regions on the recombination processes in proton-irradiated p-type silicon. The efficiency of introduction of disordered regions was calculated allowing for the non-Rutherford nature of the scattering of protons of $E \geq 10$ MeV energies by the silicon nuclei and assuming that the formation of disordered regions was characterized by an energy threshold. The threshold energy of the formation of such regions (the energy of a primary recoil atom) was ~40 keV. The minority-carrier (electron) capture cross section of such defects was $\sim 5.6 \cdot 10^{-11}$ cm^2. The results of a study of the influence of isochronous annealing on the samples irradiated with protons of different energies were in satisfactory agreement with the proposed explanation of the influence of proton irradiation on recombination in p-type silicon. (auth)

27546 INTERACTION OF LITHIUM WITH DISORDERED REGIONS FORMED BY FAST NEUTRONS IN n-TYPE GERMANIUM. Sinishchuk, I.K.; Reznikov, M.Y. (V. I. Lenin Belorussian State University, Minsk). Sov. Phys.-Semicond. 7: No. 9, 1131-1132 (Mar 1974).

An electron-microscope study was made of disordered regions in films prepared by chemical etching of undoped and lithium-doped germanium single crystals. The density of the disordered regions was $6 \cdot 10^3$ and $2 \cdot 10^5$ cm^{-2} for the undoped and doped samples, respectively. The size of the disordered regions was up to 1000 Å, comparable with the space-charge regions in the original germanium crystals. An analysis of the Hall effect data indicated that two acceptor levels ($E_v + 0.18$ and $E_v + 0.09$ eV) formed after the n-p conversion. A single-stage annealing at 170-180°C destroyed these levels. A comparison of the results of γ-ray and neutron irradiation of lithium-doped germanium indicated that indentical levels formed in both cases. Hence, it was concluded that these levels were due to LiVV complexes. The lower density of the disordered regions in the lithium-doped samples, the accelerated annealing, and the formation of the $E_v + 0.18$ and $E_v + 0.09$ eV levels suggested that the disordered regions contained vacancies and divacancies. (auth)

27547 ANNEALING OF RADIATION DEFECTS IN PLASTICALLY DEFORMED InSb CRYSTALS. Katsiashvili, R.G.; Kurdiani, N.I. Sov. Phys.-Semicond. 7: No. 9, 1141-1143 (Mar 1974).

An investigation was made of the isochronous annealing of radiation defects in InSb containing dislocations introduced in an earlier treatment. An analysis of the electrical properties of the deformed and irradiated samples demonstrated that the radiation defects interacted with dislocations during irradiation, producing complexes composed of dislocations and disordered regions. These complexes had an energy level $E_c - 0.02$ eV. The presence of such complexes increased the value of $N_d - N_a$. It was established that isochronous annealing in the 100-250°C range reduced the electron density and mobility to values close to those found for deformed InSb crystals before irradiation. The annealing of defects in the irradiated crystals was a first-order reaction with an activation energy of 0.54 eV. The heat treatment of the deformed and irradiated crystals at 190°C evidently altered the structure of the original complexes. This was demonstrated by a change in the energy of these complexes and in the nature of carrier scattering after annealing at this temperature. (auth)

27548 SUBTHRESHOLD IMPACT MECHANISMS IN THE FORMATION OF RADIATION DEFECTS IN SEMICONDUCTORS. Iskanderova, Z.A.; Kiv, A.E.; Malkin, A.A.; Yanchuk, V.A. (Krivorog State Pedagogical Institute). Sov. Phys.-Semicond. 7: No. 9, 1172-1174 (Mar 1974).

The ionization impact mechanism in the formation of radiation defects is considered in the specific case of the crystal lattice of silicon. It is shown that during the lifetime of the ionized state of an atomic core ($\tau_i \leq 10^{-14}$ sec) the Coulomb repulsion force may cause an accumulation of the momentum sufficient for dynamic expulsion of an atom to an interstice. The cross section for the formation of a defect by this mechanism is found to be $\sigma \approx 10^{-24}$ cm^2. Direct formation of divacancies is expected on the basis of the impact mechanism under discussion. (auth)

27549 ATOMIC DISPLACEMENT CASCADES IN Ge AND Si (machine modeling). Akilov, Y.Z.; Lenchenko, V.M. (Institute of Nuclear Physics, Academy of Sciences of the Uzbek SSR, Ulugbek). Sov. Phys.-Semicond. 8: No. 1, 18-22 (July 1974).

A theory of consecutive pair collisions of atoms in solids, allowing for the lattice structure, was used in a computer analysis of cascades of displacement collisions in Ge and Si single crystals. In these calculations allowance was made for the energy losses in long-range and inelastic collisions of atoms and for the thermal vibrations of the lattice atoms.

A study was made of the structure of disordered regions generated by recoil atoms of energies E=10, 30, and 50 keV. It was found that the channeling of fast atoms caused the displacement cascade to split into a number of regions separated by distances equal to the range of channeled atoms (100–500 Å for 30 and 50 keV cascades in Ge and Si). Each subcascade was usually initated by a secondary recoil atom of 3–10 keV energy and it was found that interstitial atoms were separated by considerable distances from vacancies inside each subcascade. This separation increased considerably when we allowed for the spontaneous intracascade annealing of closely spaced defects. The results obtained should help in the interpretation of the results of nuclear and ionic bombardment of semiconducting materials. (auth)

27550 BEHAVIOR OF GROUP IV ELEMENTS INTRODUCED INTO INDIUM ARSENIDE BY ION IMPLANTATION. Guseva, M.I.; Zotova, N.V.; Koval', A.V.; Nasledov, D.N. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Semicond. 8: No. 1, 34-36 (July 1974).

A study was made of the properties of layers obtained by implanting Xe^+, Ar^+, Ge^+, and Si^+ 40–keV ions in n–type indium arsenide. It was found that the radiation defects formed by bombardment with inert–gas ions were almost completely healed at $T_{ann}=600-700°C$. When n–type indium arsenide was bombarded with group IV ions, the following phenomena were observed: After annealing at temperatures up to 400°C, germanium and silicon preferentially occupied the In sublattice, becoming shallow donors; in the case of annealing above 600°C, the Ge^+ and Si^+ ions began to replace also the As^+ atoms, forming acceptor levels. The position of the Ge acceptor level was estimated to be ~14 meV, and that of Si was ~20 meV above the top of the valence band. (auth)

27551 MODEL OF THE PROCESS OF FORMATION OF γ–RADIATION DEFECTS IN GERMANIUM DOPED WITH GROUP V IMPURITIES. Mashovets, T.V.; Emtsev, V.V.; Abdurakhmanova, S.N. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Semicond. 8: No. 1, 59-64 (July 1974).

A model of the process of formation of radiation defects in germanium is developed on the basis of the experimental information on the formation and annealing of defects in n–type germanium in the course of γ–ray bombardment (up to doses causing conversion of the type of conduction). In this model impurity atoms of group V are regarded as effective centers of the recombination of primary defects (vacancies and interstitial germanium atoms). This model satisfactorily described the main experimental observations and the characteristic features of the kinetics of accumulation of radiation centers. (auth)

27552 RESISTIVITY OF SILICON SUBJECTED TO NEUTRON BOMBARDMENT AND ANNEALING. Mordkovich, V.N.; Solov'ev, S.P.; Temper, E.M.; Kharchenko, V.A. Sov. Phys.–Semicond. 8: No. 1, 139-140 (July 1974).

We study the electrical resistivity of silicon as a function of isochronous annealing. The sample was irradiated with neutrons from a water-cooled nuclear reactor. (AIP)

27553 INFLUENCE OF THE TYPE OF GROUP V DOPANT ON THE ANNEALING OF γ RADIATION DEFECTS IN GERMANIUM. Abdurakhmanova, S.N.; Dostkhodzhaev, T.; Mashovets, T.V. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Semicond. 7: No. 9, 1229-1230 (Mar 1974).

We report on the isochronous annealing of n-type germanium doped with P, As, Sb, and Bi. Irradiation is done with Co^{60} γ-rays, and we discuss the concentration of defects responsible for the $E_c-0.2$ eV level. (AIP)

27554 DISTRIBUTION OF DEFECTS WITH DEPTH IN SILICON IRRADIATED WITH 80–keV LITHIUM IONS. Baranova, E.K.; Gusev, V.M.; Strel'tsov, L.N. (I. V. Kurchatov Institute of Atomic Energy, Moscow). Sov. Phys.–Semicond. 7: No. 9, 1239-1240 (Mar 1974).

We report on a study of the distribution of defects with depth in silicon irradiated by lithium ions. We have measured the infrared absorption coefficient of samples whose thicknesses were varied by etching.

27555 MORPHOLOGY OF POLYOXYMETHYLENE CRYSTALS GROWN INSIDE IRRADIATED TETROXANE AND PENTOXANE CRYSTALS. Reneker, D. H.; Colson, J. P. (Inst. for Materials Research, Washington, DC). pp 74-75 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816–.

Samples of tetroxane and pentoxane were prepared and irradiated by alpha particles. Also, since x-rays were used to initiate the polymerization reaction in earlier investigations of pentoxane some samples of pentoxane were initiated by exposure to a beam of 40 kilovolt x-rays. After irradiation the tetroxane samples were heated for times of from one to three hours at temperatures ranging from 75 to 105°C. The pentoxane samples were heated at 58°C for 18 hours. Polymer crystals grew during this heat treatment. The unreacted monomer was removed by sublimation in a vacuum. The polymer crystals were shadowed and examined in the electron microscope using a very low beam intensity. Results are discussed using micrographs. (JRD)

27556 RADIATION DAMAGE AND HIGH RESOLUTION BIOLOGICAL ELECTRON MICROSCOPY. Glaeser, R. M. (Univ. of California, Berkeley). pp 226-227 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816–.

Results of measurements of Ncr (critical radiation exposure for a specified damage end point) are presented for valine polyethylene, uranyl-stained catalase, cytosine, phthalocyanine, and hexadecachlorophtalocyanine. (JRD)

27557 REVIEW OF THE RADIATION DAMAGE PROBLEM OF ORGANIC SPECIMENS IN ELECTRON MICROSCOPY. Reimer, L. (Univ., Munich). pp 476-477 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816–.

Research is reported directed to determination of the minimum radiation dose required to produce secondary damage, which can be measured quantitatively by a chemical or physical effect in thin specimens. Discussions are included on microorganisms, aromatic compounds, and effects of low temperature. A scale of radiation damage as functions of electron current density and exposure time is included. (JRD)

27558 ELECTRON RADIATION DAMAGE ON THIN FILMS OF PHENYALANINE. Lin, P. S. D. (Univ. of Chicago). pp 484-485 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816–.

Consecutive observation of the mass loss and change in electron energy loss spectra are being carried on in a simple field emission scanning microscope. The specimens are prepared by slow sublimation onto thin carbon films on a copper grid. Results show that (1) the π-electron system in phenylalanine may be assumed to be toluene, (2) this part of the molecule constitutes about 55% of the molecular weight, and (3) amino acids appear to be most sensitive at the α-carbon site, it may be inferred that the breakage of the bond from α-carbon to the toluene-like part of the molecule is probably responsible for the mass loss, and that the toluene-like part is left behind when the mass loss is almost completed. In general, considering the rapid rate at which mass is lost, radiation damage inside the electron microscope is unavoidable. It is most desirable to study such processes right inside a microscope. Results of this experiment indicate that a microscope with the ability to analyze inelastic events is of value for such radiation damage studies, particularly for those molecules that have characteristic peaks in the energy loss spectra. (auth)

27559 THERMOLUMINESCENCE AND F CENTRE THERMAL ANNEALING IN HEAVILY IRRADIATED KCL AND NaCl CRYSTALS. Ausin, V.; Alvarez Rivas, J. L. (Junta de Energia Nuclear, Madrid). J. Phys., C. (London); 7: No. 13, 2255-2262 (7 Jul 1974).

It has been observed that the thermoluminescence of heavily gamma-irradiated crystals of NaCl and KCl is inhibited up to temperatures higher than those corresponding to less irradiated crystals. In NaCl it is clearly seen that the vacancy-center aggregation processes including the formation of the colloidal band are operative before thermoluminescence occurs. During the thermal bleaching of the colloidal band F centers are produced which in turn are annihilated by interstitials. The temperature of the maxima of the glow peak agrees well with the temperature at which the radiation-induced hardening anneals out. As in the model proposed in a previous paper, it is concluded that the thermoluminescence in irradiated alkali halides is due to the recombination of mobile interstitials with vacancy centers; at some stage in this process light is emitted. (auth)

27560 PROTON MAGNETIC RESONANCE LINE SHAPES IN THE TITANIUM AND ZIRCONIUM HYDRIDES. Nakamura, K.

(National Research Inst. for Metals, Tokyo). J. Magn. Resonance; 14: No. 1, 31-43(Apr 1974).

The proton magnetic resonance in the polycrystalline hydrides of titanium and zirconium were observed and the root mean second moments ($M_2^{1/2}$), root mean fourth moments ($M_4^{1/2}$), the ratios M_4^4/M_2^2, $\Delta H_{ms1}/2M_2^{1/2}$, and $\Delta H_s/\Delta H_{ms1}$ were obtained. It was confirmed that the observed M_4^4/M_2^2 values of the proton resonance in the nearly stoichiometric titanium hydrides agree well with the theoretical value of O'Reilly and Tsang (Phys. Rev.; 128: 2639(1962)) for a polycrystalline simple cubic lattice. Three theoretical line shapes on the different bases, i.e., the analytical shape by Abraham, the Green's function formalism by Mansfield, and the information theory by Powles and Carazaa, were compared with the experimental line shapes of the hydrides. The agreements were found to be satisfactory if the line broadening source is purely a dipolar interaction. (auth)

27561 USE OF HEAVY IONS FOR THE EVALUATION OF THE POLYMER STABILITY. Casnati, E.; Marchetti, M.; Tommasino, L. (CNEN, Casaccia, Italy). Int. J. Appl. Radiat. Isotop.; 25: No. 7, 307-313(Jul 1974).

The surface etching rate V_b and the etching rate along the track V_t are important parameters for the registration characteristics of damage tracks from heavy ions on insulators. For organic dielectrics these parameters are altered by morphological and chemical changes of such materials. Efforts have been made to show that the determination of the etching parameters are useful for the analysis of the polymer stability. Preliminary investigations are reported dealing with the thermal stability of different polymers, such as polyethylene terephthalate, cellulose triacetate, cellulose acetobutyrate and cellulose nitrate. It is shown that the etching parameters are altered by different thermal treatments in a way somewhat related to the data obtained by a differential scanning calorimeter. In particular with this new method it is possible to evaluate the stability of polymer films a few microns thick, even while they are used as varnish. (auth)

27562 PHASE EQUILIBRIUM CONDITIONS FOR THE HYDROGEN-DEUTERIUM SYSTEM IN THE TEMPERATURE RANGE 14 TO 20°K. Bereznyak, N. G.; Bogoyavlenskii, I. V.; Karnatsevich, L. V.; Sheinina, A. A. (Kharkov Physico-Chemical Inst.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 3, 472-481(Mar 1974). (In Russian).

Precise quantitative data are reported for phase equilibrium conditions of the eH_2-eD_2 system in the vapor-liquid, vapor-crystal, and liquid-crystal states in the temperature range 14 to 20°K. The thermodynamic compatibility is shown of different parts of the phase diagrams based on the Gibbs-Duhem equation. The coefficients of hydrogen isotope distribution between the liquid and vapor phases were calculated as a function of temperature and concentration of the liquid solution. (tr-auth)

27563 ACCELERATION OF THE DIFFUSION OF IMPURITIES BY A PRELIMINARY ION BOMBARDMENT. Zelevinskaya, V.M.; Kachurin, G.A.; Pridachin, N.B. (Institute of Semiconductor Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.-Semicond. 8: No. 2, 252-253 (Aug 1974).

The diffusion of Sn in GaAs by a preliminary irradiation of the doped surface layer with inert-gas ions has definite advantages over the conventional diffusion and ion doping and completely eliminates the effects associated with channeling. It was found that the bombardment with Ar ions resulted in an anomalously deep penetration of tin in the course of subsequent diffusion. (AIP)

27564 EFFECTS OF CHANGES IN LOCAL CENTERS IN CdS SINGLE CRYSTALS CAUSED BY THE IONIZING ACTION OF γ RAYS. Dyakin, V.V.; Korsunskaya, N.E.; Markevich, I.V.; Sheinkman, M.K. (Institute of Semiconductors, Academy of Sciences of the Ukrainian SSR, Kiev). Sov. Phys.-Semicond. 8: No. 2, 281-281 (Aug 1974).

27565 OBSERVATION OF RECOMBINATION-ENHANCED DEFECT REACTIONS IN SEMICONDUCTORS. Lang, D.V.; Kimerling, L.C. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. Lett. 33: No. 8, 489-492 (19 Aug 1974).

Recombination-enhanced annealing of defects in semiconductors has been observed directly for the first time. The defects were produced in GaAs by 1-MeV electron irradiation and observed by transient-junction-capacitance techniques. The data clearly relate the enhanced defect annealing rate to electron-hole recombination processes at the defect. (auth)

27566 DIMERIZATION OF A LINEAR HEISENBERG CHAIN IN THE INSULATING PHASES OF $V_{1-x}Cr_xO_2$. Pouget, J.P.; Launois, H. (Laboratoire de Physique des Solides, Faculte des Sciences, 91-Orsay, France); Rice, T.M.; Dernier, P.; Gossard, A.; Villeneuve, G.; Hagenmuller, P. Phys. Rev. B 10: No. 5, 1801-1815 (1 Sept 1974).

The nuclear magnetic resonance (NMR) of V^{51} has been studied in the series of compounds $V_{1-x}Cr_xO_2$ between 100 and 350 K. Three insulating phases are clearly distinguished. In the low-temperature M_1 phase only one V site is seen with a positive Knight shift and electric-field gradient identical to the insulating phase of pure VO_2. At temperatures just below the metal-insulator transition a second phase M_2 is stable in which two sites are resolved. One site has a small positive Knight-shift characteristic of a paired V^{4+} site while the other has a negative Knight shift showing a localized V^{4+} site. These two sites are identified as the V atoms on the paired chains and the equispaced chains in C2/m structure of Marezio et al. At intermediate temperatures a transitional phase T is stable in which two sites can be resolved by their electric-field gradients. The two sites are progressively differentiated by increasing temperature and Cr concentration and are interpreted as arising from two sets of inequivalent paired chains, one of which is depairing with increasing temperature and Cr concentration. These results are inconsistent with the monoclinic symmetry and a disordered bond model proposed previously for the transitional phase. Triclinic splittings were observed recently by Villeneuve et al. and additional crystallographic evidence supporting this result is presented. The magnetic properties are interpreted as a set of noninteracting linear Heisenberg chains and the M_2-T transition as a dimerization of the linear Heisenberg chain. The results demonstrate a breakdown of the band model in the insulating phases. (auth)

27567 NEUTRON AND MAGNETIZATION STUDIES OF THE UP-US SYSTEM. Maglic, R.C. (Physics Department, University of Puerto Rico, Mayaguez, Puerto Rico 00708 and Argonne National Laboratory, Argonne, Illinois 60439); Lander, G.H.; Mueller, M.H.; Crangle, J.; Williams, G.S. Phys. Rev. B 10: No. 5, 1943-1950 (1 Sept 1974).

Solid solutions exist for $0 \leq x \leq 1$ in the system $UP_{1-x}S_x$. All compositions are cubic at room temperature with the NaCl crystal structure. The results of neutron-diffraction and bulk-magnetization measurements on a number of compositions are reported, with particular emphasis on the region $0.10 \leq x \leq 0.20$. For $x = 0.1$ the initial magnetic structure ($T_N = 98$ °K) is type IA; at ~85 °K this transforms to the type-I structure, but at ~50°K the structure reverts to the type IA. Bulk-magnetization experiments show that the material is metamagnetic during the high-temperature IA-I transition. The induced ferromagnetic moment has been examined by measuring the depolarization of polarized neutrons transmitted through the sample. For $x = 0.15$ the magnetic structure is type IA at all temperatures below T_N. For $x = 0.20$ an additional phase, with a 3+,3- configuration, coexists with the type-IA phase between 40 and 80 °K. Large peaks in the magnetization are also observed just below T_N for the $x = 0.15$ and 0.20 compositions. (auth)

27568 OPTICAL AND CHANNELING STUDIES OF ION-BOMBARDED GaP. Wemple, S.H.; North, J.C.; Dishman, J.M. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Appl. Phys. 45: No. 4, 1578-1589 (Apr 1974).

Below-gap optical absorption, above-gap reflectivity, photoluminescence, and He ion channeling backscattering measurements are reported for ion-bombarded GaP. Each of the four experiments provides a measure of disorder. A one-to-one correspondence exists between the absorption, reflectivity, and backscattering measurements, and all three exhibit comparable sensitivity to damage. Photoluminescence is ~100 times more sensitive. The absorption results suggest that every implanted ion species produces amorphous regions associated with each projectile and that these regions have properties very much like those of cold-deposited amorphous films. The results are interpreted in terms of a model which ascribes these amorphous regions to localized melting followed by rapid quenching to a glassy (amorphous) state in which short-range tetrahedral order remains intact. The damaged volume per bombarding ion as determined from absorption data is ~6 times larger than that determined from channeling measurements. Although the annealing experiments show considerable scatter, the damage-induced changes in absorption and reflectivity can be largely removed by annealing at ~600 °C for 30 min. Some anomalies are observed in the photoluminescence annealing results. (auth)

27569 CHARACTERIZATION OF INCOMPLETE ACTIVATION OF HIGH-DOSE BORON IMPLANTS IN SILICON. Schwettmann, F.N. (Texas Instruments Incorporated, Dallas, Texas 75222). J. Appl. Phys. 45: No. 4, 1918-1920 (Apr 1974).

The incomplete activation observed when high doses of boron ($2\times10^{15}-2\times10^{16}$ ions/cm^2) are implanted in silicon is characterized by a maximum concentration of electrically active boron that is independent of both the dose and anneal time and well below the solid solubility value. An Arrhenius plot for this concentration-temperature dependence yields an activation energy of 0.31 eV. It is suggested that the incomplete activation is due to interactions between the implanted ions. Whether the defect structure is a simple B-B pair or a cluster involving residual damage is not clear at this time. (auth)

27570 PROTON BOMBARDMENT AND ISOCHRONAL ANNEALING OF p-TYPE $Pb_{0.76}Sn_{0.24}Te$. Wang, C.C.; Tao, T.F. (Department of Electrical Engineering, Naval Postgraduate School, Monterery, California 93940); Sunier, J.W. J. Appl. Phys. 45: No. 9, 3981-3987 (Sept 1974).

The effects of low-energy proton bombardment (200-450 keV) on the electrical properties of p-type $Pb_{0.76}Sn_{0.24}Te$ have been investigated. The carrier concentrations were generally found to be reduced by the bombardment. Carrier conduction from p to n type, which depended upon the initial carrier concentration, was also observed. Samples with an initial hole concentrations in the range of low 10^{17} holes/cm^3 were changed to n type after a proton dose of approximately 5×10^{13} protons/cm^2. Type conversion was not consistent for samples with higher initial carrier concentrations. Mobilities were found to increase for type-converted samples. A slight decrease was observed for samples which did not change their type. Isochronal annealing was performed for type-converted samples. A major annealing stage was found to occur in the temperature range 90-140 °C in which the converted samples changed their conduction back to p type. This seems to limit the applicability of proton bombardment as a process to produce reliable devices. (auth)

27571 BUBBLE DOMAINS IN DOUBLE GARNET FILMS. Lin, Y.S.; Grundy, P.J. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). J. Appl. Phys. 45: No. 9, 4084-4094 (Sept 1974).

The properties of bubble domain lattices in magnetostatically coupled double garnet films are investigated. The calculated static properties of bubble lattices in both single and double garnet films are compared with the results of experiments on three double-film composites. The differences in behavior between the three composite structures, chosen to exhibit varying degrees of magnetostatic coupling, are explained quantitatively in terms of the interaction fields between bubble domains in the two magnetic films. The dependence of bubble diameter on the applied bias field has been investigated experimentally and agreement with theory is good. Stable bias field ranges for bubble lattices are also examined. Effects such as the ordering of double-bubble lattices, changes in bubble size upon coupling, and experimental observation of bubble repulsion and attraction effects are explained qualitatively. Some results on novel stacking arrangements of overlying bubble lattices and the dependence of bubble spacing in a lattice on the method of generation are briefly discussed. (auth)

27572 ION-CHANNELING AND OPTICAL ABSORPTION STUDIES OF IMPLANTATION DISORDER IN GERMANIUM. Picraux, S.T.; Stein, H.J. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 45: No. 9, 3784-3788 (Sept 1974).

Ion-channeling and optical absorption measurements are reported for lattice disorder in Ge after ion implantation at 90 K. An anneal stage is observed by ion channeling at 175 K for low-fluence Zn implants (3×10^{12}/cm^2). The annealing occurs over a much narrower temperature range (~50 K) than is observed for low-temperature implantation disorder in Si. The Ge anneal stage measured by ion channeling is shown to correlate closely with that observed by near-band-edge optical absorption measurements for these low-disorder-density implants. For high-disorder-density implants (e.g., $\gtrsim 3\times10^{13}$ Zn/cm^2) ion-channeling measurements saturate due to a loss of long-range order, while near-edge absorption measurements are still sensitive to further changes in the disorder. Following high-disorder-density implants near-edge absorption shows appreciable recovery below room temperature, while ion channeling shows recovery of the long-range order at temperatures ~450 K. Thus, ion-channeling and optical absorption measurements of ion-induced disorder in Ge are shown to correlate for low-disorder-density implants and provide complementary information for high-disorder-density implants. (auth)

27573 IONIZATION DILATATION EFFECTS IN FUSED SILICA FROM 2 TO 18-keV ELECTRON IRRADIATION. Norris, C.B.; EerNisse, E.P. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 45: No. 9, 3876-3882 (Sept 1974).

We have used low-energy electron irradiations in conjunction with a bending-cantilever-plate technique to investigate the volume dilatations produced by ionization effects in fused silica. Our irradiations generally cause compaction in agreement with previous data from high-energy electron irradiations, but we consistently observe a slowly saturating compaction-dose relationship rather than the sublinear power-law relationship seen in the high-energy data. Our results show agreement with the apparent ionization compaction effect extracted from low-dose-rate $^1H^+$-ion-implantation experiments. We find no dose-rate dependence in the electron ionization compaction effect, in marked contrast with the apparent ionization compaction effect in the implantation experiments. We therefore conclude that the enhancement of the apparent ionization compaction effect at high dose rates in the implantation experiments results from an interaction between the ionization and the atomic displacements accompanying the implanation. By probing to various depths at a constant dose and dose rate, we find that the electron irradiation compaction effect is generally enhanced within several hundred angstroms of the sample surface. There is no apparent threshold for onset of the compaction mechanism for incident electron energies between 2.2 and 18 keV. Finally, we observe the low-fluence expansion effect in impure fused silica as seen by other workers but establish here that it is primarily an ionization-stimulated phenomenon that occurs only when the irradiation current varies with time. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

27574 (IAEA-R-993-F) MEASUREMENT OF NEUTRON DECAY CONSTANT IN A HIGHLY SUBCRITICAL REACTOR AS A SAFEGUARD METHOD. Final Report, 1 January 1972–31 December 1973. Krasin, A. K.; Zaretskii, A. I.; Buznitskii, G. I.; Sapozhnikov, V. V.; Yaroshevich, O. I. (International Atomic Energy Agency, Vienna (Austria)). Oct 1973. 35p. (In Russian). INIS.

A method of verifying the fuel content of fuel elements is discussed. The method is based on the measurement and comparison of prompt neutron decay constants in "reference" and "test" subcritical assemblies. Physical design specifications for a subcritical assembly intended for inspection purposes that ensure reliability of the verification procedure, nuclear safety during inspection and relative simplicity of construction are formulated. Despite uncertainties in the quantitative evaluation of changes in fuel content in the "test" assembly, the proposed method makes it possible to establish whether there has been removal of fuel in a "test" batch of fuel elements. (INIS)

27575 (IAEA-R-997-F) DEVELOPMENT OF AN APPLICATION TECHNIQUE TO VERIFY THE FISSILE MATERIAL OF AN IRRADIATED FUEL IN A ZERO ENERGY REACTOR. Final Report, 1 January 1971–31 December 1971. Terry, D. R.; Hornsby, J. B.; Brown, F.; Ross, A. E. (International Atomic Energy Agency, Vienna (Austria)). Dec 1972. 14p. INIS.

Several non-destructive methods are studied from the point of view of their application for the IAEA safeguards verification of the Pu content of irradiated fuel from zero-energy fast reactors. The techniques considered are: (a) calorimetry, (b) active interrogation techniques, (c) semi-conductor gamma spectrometry, (d) scintillation gamma spectrometry, and (e) spontaneous fission neutron counting. (INIS)

27576 NUCLEAR FUEL BATCH WEIGHING. Meas. Contr.; 7: No. 8, 283(Aug 1974).

Separating ^{235}U from ^{238}U for use as fuel in second generation nuclear power stations is an operation demanding strict weight control over the input of raw material, precise monitoring of the process flow and accurate determination of the output of fuel produced. Specially designed weight equipment to carry out these measurements in a centrifuge isotope separation plant, is described. Accurate records of the weight of the raw material, uranium hexafluoride, and the weights of both the enriched fuel produced and the depleted tails are provided. (UK)

Disposal and Storage

Refer also to abstracts 26511, 26526, 26764–26771, 26774, 26775, and 27099.

27577 (JUL-1071-RG) CRITICALITY CALCULATIONS CONCERNING THE PROBLEM OF FINAL DEPOSITION OF AVR FUEL ELEMENTS IN THE SALT MINE ASSE. Gerwin, H.; Scherer, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). May 1974. 28p. (In German). Dep. NTIS (US Sales Only) $4.50.

Final deposition of reactor fuel may be done only if criticality is excluded in any case and for any time. For spherical fuel elements of the high-temperature reactor AVR at Jülich with a burnup of 50% FIFA, boundary conditions for the final depositions are investigated by several hypothetical changes in configuration of the deposit. For a deposition scheme, discussed at present, only the non-realistic case of forming a compact sphere of dry fuel elements without brine impregnation seems to be a safety problem. This leads to a limitation of the fuel charge up to 16,000 fuel spheres per borehole. There are no objections to storage of up to 50,000 spheres per borehole for all the other investigated deformations. (auth)

27578 (N-74-22504) FEASIBILITY OF SPACE DISPOSAL OF RADIOACTIVE NUCLEAR WASTE. 2. Technical Summary. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). May 1974. 130p. (NASA-TM-X-2912; E-7676). NTIS $4.75.

The feasibility of transporting radioactive waste produced in the process of generating electricity in nuclear powerplants into space for ultimate disposal was investigated at the request of the AEC as a NASA in-house effort. The investigation is part of a broad AEC study of methods for long-term storage or disposal of radioactive waste. The results of the study indicate that transporting specific radioactive wastes, particularly the actinides with very long half-lives, into space using the space shuttle/tug as the launch system, appears feasible from the engineering and safety viewpoints. The space transportation costs for ejecting the actinides out of the solar system would represent less than a 5% increase in the average consumer's electric bill. (auth)

27579 PROBLEM OF RADIOACTIVE WASTES IN A REPROCESSING PLANT. Detilleux, E. (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). J. Belge Radiol.; 57: No. 2, 107-115(1974). (In French).

The composition, nature, and characteristics of radioactive waste produced by the operation of a nuclear fuel reprocessing plant are examined. For each type of waste and certain special releases such as rare gases and tritium, the used or considered conditioning techniques are discussed. Particular attention is paid to the problems posed by long-term storage of high-level liquid waste. The options available regarding the management of radioactive waste indicate a need for international collaboration in close association with public authorities. (auth)

27580 MANAGEMENT OF HIGH LEVEL RADIOACTIVE WASTE. Grover, J. R. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Ann. Nucl. Sci. Eng.; 1: No. 5, 329-331(May 1974).

Many groups of workers throughout the world are considering possible methods of storage or disposal of high level fission product wastes. It is the view of the United Kingdom that these wastes must be fixed in solids and must be retrievable, i.e., they should be stored and not disposed of. Mankind can plan ahead for a hundred years with a reasonable degree of safety, it is doubtful whether he can anticipate or plan ahead for a thousand years, and it is quite unrealistic to consider any non-retrievable disposal for periods as long as 10^5 yr, which is a quite incomprehensible period of time. (auth)

27581 PRINCIPLES OF RADIOACTIVE WASTE MANAGEMENT. Morley, F.; Bryant, P. M. (National Radiological Protection Board, Harwell, Eng.). Environ. Change; 2: No. 6, 409-415(Feb 1974).

A description is given of the principles of radiation protection relevant to waste management policy and practice, with particular emphasis on issues which are at present the subject of public discussion. In the United Kingdom the policy was set out in 1958 in a White Paper entitled "The Control of Radioactive Wastes" and was given effect by the Radioactive Substances Act, 1960. The policy is consistent with the present recommendations (of which a summary is given) of the International Commission on Radiological Protection. Some account is given of the radioactive wastes arising from various types of reactor and from chemical reprocessing of irradiated fuel, and an outline of the principal methods adopted for disposal or storage. (UK)

Handling Equipment and Procedures

Refer also to abstract 27213.

27582 (RFP-2222) CRITICALITY DRAIN PERFORMANCE STUDY. Lehmkuhl, G. D. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 29 Aug 1974. Contract AT(29-1)-1106. 12p. Dep. NTIS $4.00.

A study was made to determine the liquid head necessary to sustain various liquid flow rates in glovebox criticality drains. Liquid head is the height of liquid above a drain outlet opening in a glovebox. One bottom and side drain each for 1-, 2-, and 3-in. dia pipe were simulated in a glovebox model. The 1-in. side and bottom drains and the 2- and 3-in. side drains require higher liquid heads than the other 2 drains. A 2-in. side drain, for example, requires a 1.7-in. head to flow 12 gpm while a 2-in. bottom drain requires only a 0.7-in. head. These test data can be used in the design of gloveboxes and for evaluation of existing glovebox criticality drains. Probable leak rates into gloveboxes can be used with these test data to predict probable liquid levels in the gloveboxes. (auth)

27583 APPARATUS FOR STORING AND PROCESSING FISSIONABLE SUBSTANCES. Dubovskii, B. G.; Bogatyrev, V. K.; Vladykov, G. M.; Sviridenko, V. K. US Patent 3,832,563. 27 Aug 1974. Filed Date 7 Aug 1972. 6p.

An apparatus is described for storing and processing fissionable substances provided with a protective shield. The latter consists of a layer of a neutron-absorbing material, followed by a layer of a neutron-retarding material. The layer of a neutron-absorbing material is located in a direct proximity to a vessel

with a fissionable substance contained therein. The layer of a neutron-retarding material is made with alternating projections and depressions facing the layer of a neutron-absorbing material. (Official Gazette)

Transportation

27584 CONTAINER FOR THE TRANSPORT OF IRRADIATED MATERIALS AND ITS FABRICATION. van Impe, J.; Lecerf, H.; Heylen, P. R. (to ENI, Aartselaar, Belgium). Belgian Patent 808,731. 16 Apr 1974. 23p. (In French).

A container for the transport of irradiated material is described. It consists of a container, at least one tube for the irradiated materials and a coolant fluid inside the container. The container is surrounded by a γ biological shield and a neutron shield around the biological shield. The tube is at least partially surrounded by a metallic block with good thermal conductivity which is in contact with both the tube and the internal wall of the container. (tr-auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

27585 (CONF-730907-P2, pp 841-845) SOME PRELIMINARY INVESTIGATIONS ON THE CONTRIBUTION OF MUONS TO THE STRAY RADIATION LEVEL AROUND THE CERN 28 GeV PROTON SYNCHROTRON. Hoefert, M.; Baarli, J. (CERN, Geneva). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Below a few GeV the predominant radiation in the environment of accelerator installations is stray neutrons. Muons may however become dominant if pions and kaons produced by the interacting primary beam are allowed to decay in the course of free flight and the resulting muons in forward direction are not sufficiently shielded. Measurements with a counter telescope allowing for the determination of their angular distribution behind the shield around the beam direction are reported. The attenuation length for muon spectra from the decay of pions of a few GeV in several materials was determined and is compared with theoretical values. The measurements show in addition the contribution to stray radiation levels by other components penetrating the main shield of the accelerator. Their relative importance at different distances and their environmental impact are discussed. (auth)

27586 (GSI-tr-11/74) PROSPECTS FOR THE DEVELOPMENT OF CYCLIC HIGH-CURRENT ACCELERATORS AND MESOTRON FACTORIES. Dschelepow, W. P.; Dmitrijewskij, W. P.; Kolga, W. W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)). May 1974. 14p. (In German). INIS.

3 figs.; 1 tab.; 19 refs. Translation of the report JINR-P9-7833.

The essential problems of the development of cyclic high-current accelerators (phasotrons), in particular the increase of the average particle beam current are discussed and partly compared with linear accelerators. Isochronous cyclotron models to accelerate protons in the GeV region (with intensive focussing) for 100 mA beam intensity are dealt with in regard to the building of a high-current K-meson generator. (GE)

27587 TEREK-2 HIGH-CURRENT PULSED ELECTRON ACCELERATOR. Bondar, Yu. F.; Koval'chuk, B. M.; Rybalov, A. M.; Strelkov, P. S. (Inst. of Atmospheric Optics, Tomsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 17-19(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 25-27(1974).

A pulsed electron accelerator having a current-pulse amplitude of up to 10 kA and a pulse length of 30 nsec is described. The energy of the electrons in the beam may be controlled smoothly from 200 to 550 keV. The structural peculiarities of the accelerator allow injection of a beam into a quasi-stationary magnetic field without introducing substantial distortions into the field. (auth)

27588 HIGH-POWER NANOSECOND ELECTRON ACCELERATOR WITH INDUCTIVE STORAGE. Koval'chuk, B.M.; Kotov, Y.A.; Mesyats, G.A. (Atmospheric Optics Institute, Academy of Sciences of the USSR, Tomsk). Sov. Phys.-Tech. Phys. 19: No. 1, 136-137 (July 1974).

An electron accelerator has been developed in which the primary energy storage is the capacity of a Marks generator (300 kV, $12 \cdot 10^{-3}$ pF). The Marks generator discharges into the inductive energy storage through several parallel copper wires 50 μ in diameter, the inductive storage being the self-inductance of the generator. The wires explode at current maximum. The energy stored in the inductor is transferred to a diode with a multifront cathode. The accelerator yields an electron beam with an electron energy of 600 keV, a current of 5.2 kA, and pulse about 100 nsec long. (auth)

27589 CALCULATIONS AND MEASUREMENTS ON THE MAXIMUM ENERGY OF SECONDARY ELECTRONS IN INCLINED-FIELD ACCELERATION TUBES. Kiss, A.; Koltay, E.; Szabo, Gy. (Inst. of Nuclear Research, Hungarian Acad. of Sci., Debrecen, Hungary). Nucl. Instrum. Methods; 117: No. 2, 325-329(15 May 1974).

Trajectory calculations have been carried out for secondary electrons emitted on the electrodes and in the interelectrode gaps of inclined-field acceleration tubes. It was shown that a number of trajectories originating in the neighborhood of the prismatic field sections will be inflected in the paraxial region. Consequently, the corresponding electrons will be accelerated to considerable energies before being stopped by other electrodes. The presence of high-energy electrons in inclined-field tubes was experimentally proved by X-ray measurements around the 5 MV Van de Graaff generator in this Institute. Similar measurements performed with a homogeneous field tube enable us to compare the behavior of tubes of different types. (auth)

Auxiliaries and Components

Refer also to abstract 28346.

27590 HIGH-FIELD (5T) PULSED SUPERCONDUCTING DIPOLE MAGNET. Coupland, J. H. (Science Research Council, Chilton, Eng.). Proc. Inst. Elec. Eng. (London); 121: No. 7, 771-778(Jul 1974).

An account of the design, construction and testing of a pulsed superconducting dipole magnet of novel design known as AC4 is given. It represents a stage in the development of very-high-field magnets for possible use in a super-high-energy proton synchrotron. Though the magnet does not quite attain the necessary field homogeneity, the extensive tests reported here provide confidence and much relevant information for future designs using saturated iron. From the electrical measurements of total losses for unidirectional and bidirectional pulsing, an estimate can be made of the contribution from the iron yoke and shows that the hysteretic losses in the superconductor are about as expected. (auth)

27591 SIMPLE METHOD FOR MEASURING THE ENERGY OF ELECTRONS IN THE BEAM OF AN ACCELERATOR. Balashov, A. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 20-21(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 27-28(1974).

A method for measuring the energy of extracted beams of electron accelerators in the 2 to 10 MeV range by means of partial absorption of the beam in a metal plate of known thickness is described. The method is distinguished by its simplicity, fair accuracy, and rapidity with which the measurements can be performed. (auth)

27592 THEORETICAL MODEL FOR AN ADVANCED BREMSSTRAHLUNG CONVERTER. Halbleib, J.A. Sr. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 45: No. 9, 4103-4109 (Sept 1974).

The model described may be used to predict the output of a bremsstrahlung converter system consisting of one or more thin converter foils immersed in a uniform magnetic field whose direction is oblique to the foil normal(s). This model is a superposition of the vacuum helical trajectories of the electrons and a Monte Carlo collisional transport of photons and electrons. Predictions of radiation environments of these "advanced" converters are compared with those of more conventional converters. It is shown that one may extract a comparable, if not greater, amount of bremsstrahlung energy from the relatively thin advanced converters and that the spectra are considerably softer. Because of the higher solid-angle reduction inherent in the advanced converter geometries, however, it is concluded that they will not lead to significantly higher point bremsstrahlung deposition in irradiated materials. Nevertheless, higher deposition should be possible where large exposure areas are required. (auth)

27593 FLUX DISTRIBUTION IN A STEEL SIDE SHIELD. Bennett, G. W.; Levine, G. S.; Foelsche, H. W.; Toohig, T. E. (Brookhaven National Lab., Upton, N. Y. (USA)). Nucl. Instrum. Methods; 118: No. 1, 149-155(1 Jun 1974).

Measurement has been made of the distribution of secondary particles in a steel side shield near a tungsten alloy target illuminated by high-energy protons. Secondaries were detected using ^{11}C activation, and the effect of unspecified targets was cancelled by subtracting "target-out" data. The resulting distribution does not support a uniform attenuation length. These results provide design criteria for steel side shields, particularly close-coupled shields. (auth)

27594 METHOD FOR THE STUDY OF THE SPATIO-TEMPORAL DISTRIBUTION OF A HIGH-POWER PULSED ELECTRON BEAM. Arnoud, J. C.; Roche, M. (CEA Centre d'Etudes de Valduc, 21-Is-sur-Tille (France)); Boivin, M.; Cauchois, Y. (Paris-6 Univ., 75 (France). Lab. de Chimie Physique). Nucl. Instrum. Methods; 117: No. 2, 487-490(15 May 1974). (In French).

A new means of analyzing a high-power pulsed electron beam is reported. The bremsstrahlung emitted from a target placed in the beam is measured using luminescent optical fibres. The calibration, carried out with a constant beam accelerator, shows that the spatial distribution is very good. (auth)

27595 DESIGN AND OPERATION OF A CHARGE-STATE SEPARATOR BASED ON OFFSET MAGNETIC QUADRUPOLES. Eastham, D. A.; Joy, T.; Tait, N. R. S. (Science Research Council, Daresbury (UK). Daresbury Lab.). Nucl. Instrum. Methods; 117: No. 2, 495-500 (15 May 1974).

A new type of charge-state separator, employing a magnetic quadrupole triplet as a dispersive element is described. The predicted operation is confirmed experimentally for oxygen and argon ion beams of the quality expected in the centre terminal of a large electrostatic tandem accelerator. (auth)

27596 FORMATION OF SHORT BUNCHES IN AN ELECTRON BEAM WITH THE AID OF TWO DEFLECTING CAVITIES. Boussoukaya, M.; Septier, A. (Paris-11 Univ., 91-Orsay (France). Inst. d'Electronique Fondamentale). Nucl. Instrum. Methods; 117: No. 2, 321-324 (15 May 1974). (In French).

A theoretical study of electron beam deflection in rectangular cavities by TM_{120} mode in S-band is done; a formula is given to calculate rf power needed to obtain very short bunches of electrons of phase width $\Delta\phi_0$, at ν = 2850 MHz/s. Experimental and theoretical results are in good agreement. (auth)

Ion Sources and Injection and Extraction Systems

27597 (IFVE-SKU-72-98) FAST EXTRACTION OF PROTONS FROM THE 70-GeV ACCELERATOR. Ejection Channel A. Bossart, R.; Van Breugel, H.; Herin, S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 44p. (In Russian). INIS.

The work on the design, construction, and alignment of the system for the fast extraction of protons from the IHEP 70-GeV accelerator is described in detail. The construction characteristics of the system, the calculated parameters and tolerances, imposed on the equipment are given. The results of the alignment in different regimes required for physics experiments are reported. (tr-auth)

27598 PROTON EXTRACTION FROM THE 70-GeV ACCELERATOR FOR THE LUDMILA LIQUID-HYDROGEN CHAMBER (extraction SYSTEM S). Aseev, A.A.; Drozhdin, A.I.; Zelenov, B.A.; Merker, É.A.; Moizhes, L.L.; Myznikov, K.P.; Roshchin, A.A.; Tatarenko, V.M.; Kholodenko, M.A.; Artemov, A.D.; Vaulin, L.N.; Gordin, V.I.; Kovalevskii, I.I.; Rozhkov, V.N.; Suvorov, M.M.; Sudarushkin, A.S.; Chuiko, V.I. (Institute of High-Energy Physics, Serpukhov Efremov Scientific-Research Institute of Electronics, Physics, and Automation, Leningrad). Sov. Phys.-Tech. Phys. 19: No. 1, 70-76 (July 1974).

Extraction of the proton beam from the 70-GeV accelerator of the Institute of High-Energy Physics for the Ludmila liquid-hydrogen chamber is described. The features of the beam extraction and transport systems, the design parameters, the tolerances, and the characteristics of the apparatus are discussed. The method used to align the system is discussed. The results of the alignment of the system are reported. (auth)

27599 PROTOTYPE POLARIZED-ELECTRON SOURCE THROUGH ELECTRON-HYDROGEN SPIN EXCHANGE WITH TEFLON CONTAINMENT OF HYDROGEN AND A LONGITUDINAL MAGNETIC TRAP. Krisciokaitis-Krisst, R.; Peterson, W. K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Nucl. Instrum. Methods; 118: No. 1, 157-163 (1 Jun 1974).

A prototype polarized-electron source has been constructed and results are reported. It is based on electron-hydrogen spin-exchange collisions using a longitudinal-geometry electron trap and teflon coatings to contain the state-selected atomic-hydrogen target. This scaled-down prototype is compatible with an electron linac and produces an extracted pulse of about 10^7 electrons/μs with about 60% polarization and 50 to 60 Hz repetition rate. Construction of a more intense (10^{10} or more electrons per pulse) full-scale device based upon this technique is also discussed. The average measured total electron-hydrogen spin-exchange cross section for 5 to 10 eV electrons is estimated to be in the range (0.5 to 1.55) $\times 10^{-15}$ cm^2. (auth)

Ion Optics and Field Calculations

27600 (ITEF-54) TRANSIENT PROCESSES IN FORMING DENSE ELECTRON RINGS. Globenko, Yu. G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 20p. (In Russian). INIS.

It was shown that during injection of linear charged particle beams into areas filled by a magnetic field an increase of the momentum scattering occurs because of the longitudinal Coulomb repulsion and because of the gradual increase of the circulating current. The increase of the momentum scattering depends on the radius of injection and of the total injected current. It leads to radial widening of the beam after injection, which in turn depends only on the total injected current and the energy of injection. If the injected beam is placed close to the conducting surface, then the effect discussed can be reduced. This effect limits the possibility of obtaining large density in the circular charged particle beam and represent, particularly interest for coherent methods of acceleration. (tr-auth)

27601 (ITEF-63) ESTIMATION OF BUILDING POSSIBILITY OF THE COLLECTIVE ACCELERATOR WITH MULTIPLE UTILIZATION OF ELECTRON RINGS. Kapchinskii, I. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 16p. (In Russian). INIS.

The effects leading to an increase of the phase volume of electrons in fluctuating rings were examined. It is shown that heating of the electrons occurs very rapidly which indicates that repeated use of the same ring in order to increase the efficiency of the collective accelerator is impossible. (tr-auth)

27602 (UCID-15512) COHERENT SPACE CHARGE LIMITS IN CLOSED ORBIT HIGH INTENSITY ELECTRON MACHINES. Lamb, W. A. S.; Beal, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab). 24 Jul 1969. 5p. Dep. NTIS $4.00.

Expressions are derived for the integral resonance and the half integral resonance for the case of an unbunched beam such as a betatron. (WHK)

27603 TRANSVERSE BEAM INSTABILITY IN A RESONATOR SECTION. Kramskoi, G.D.; Kurilko, V.I.; Shendrik, V.A. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.-Tech. Phys. 18: No. 12, 1638-1642 (June 1974).

The transverse beam instability in a single resonator section is analyzed. Account is taken of the spontaneous and induced interactions of the beam with the field of a defocusing, axially asymmetric EH_{11} wave. Analytic expressions are derived for the transverse displacement of a bunch as a function of its order number, the beam current, the parameters of the section (the geometry, Q, and the accelerating field), and the external inducting forces. The threshold curents are determined. The intensity of the defocusing wave amplified by the beam is found as a function of the beam current. The theoretical results agree with the experimental data. (auth)

27604 EFFECT OF INTRAPULSE FLUCTUATIONS ON A LINEAR ACCELERATOR BEAM. Aver'yanov, G.P.; Grishaev, I.A.; Dovbnya, A.N.; Shal'nov, A.V. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khark'ov). Sov. Phys.-Tech. Phys. 18: No. 12, 1643-1645 (June 1974).

The effect of fluctuations on the energy spectrum in a linear accelerator beam is studied. Expressions are obtained which relate spectral parameters to the moments of the instability distribution function. Experimental data are presented for intrapulse frequency fluctuations and for the dependence of spectral parameters on the number of accelerating sections. It is shown that intrapulse fluctuations play an important role in the formation of spectra in accelerators at low and medium energies and that beam monochromaticity is determined mainly by the parameters of an individual bunch in a multisection accelerator. (auth)

27605 ION ACCELERATION BY DENSITY WAVES IN AN ELECTRON BEAM. Gavrilov, N. M.; Nesterovich, A. V. (Moscow Engineering-Physics Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 785-788 (Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1238-1243 (Jun 1973).

Under certain conditions, the propagation of a space-charge density wave during modulation of an electron beam by a slow electromagnetic wave propagating along the beam axis can be described by the methods of electron optics. A qualitative analysis is made of the amplification of the reference-wave field and of the possible simultaneous achievement of radial and phase stability for the ions in such a system. The results indicate that the field intensification affects the ion dynamics in devices such as traveling-wave tubes during ion acceleration and focusing. (auth)

27606 ABERRATIONS IN A STRAIGHT ION-OPTICAL ACCELERATOR. Gerasimov, E.I.; Solnyshkov, A.I.; Tarvid, G.V. (D. V. Efremov Scientific-Research Institute of Electrophysical Apparatus). Sov. Phys.-Tech. Phys. 19: No. 1, 131-133 (July 1974).

A 150–keV ion–optical accelerator with an ion current of 3 mA is investigated. The beam–parameter is investigated. The beam–parameter measurement system enables us to obtain data on the current–density distribution over the beam radius and phase diagrams in transverse planes in the different regimes of accelerator operation. The causes of distortion in the phase–volume configuration and the change in the current–density distribution in the beam cross section are investigated. The action of nonlinear focusing forces, which leads to a considerable increase in the effective phase volume, is shown to be a decisive factor. It is also possible to form beams with current–density distribution close to equilibrium, using focusing elements with strong spherical aberration. (auth)

27607 DEPENDENCE OF ION ACCELERATION ON LIMITING CURRENT IN RELATIVISTIC ELECTRON BEAMS. Straw, D.C.; Miller, R.B. (Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico 87117). Appl. Phys. Lett. 25: No. 7, 379-381 (1 Oct 1974).

A 2–MeV 15–kA 45–nsec electron beam was used to obtain high–energy deuterons when injected into a chamber filled with neutral deuterium at low pressure. It was found that ion acceleration did not occur until the electron current exceeded the space–charge limiting current, the threshold established by the acceleration model of Olson. The limiting current was varied through its dependence on the ratio of guide tube radius to injected electron beam radius. The maximum deuteron energy was measured to be 4.5 MeV for the largest guide tube to beam radius ratio. An increasing average ion energy with an increasing radius ratio was also observed. (auth)

27608 ON THE QUESTION OF CHARGED–PARTICLE MOTION IN A FOCUSED LASER FIELD. McIver, J.K. Jr.; Lubin, M.J. (Laboratory for Laser Energetics, College of Engineering and Applied Science, Rochester, New York 14627). J. Appl. Phys. 45: No. 4, 1682-1687 (Apr 1974).

The motion of an electron traversing the intense coherent electromagnetic field in the focal region of an f/0.5 aplanatic lens is calculated for the purpose of studying charged–particle acceleration. The results are compared with two simplified plane–wave models for this interaction. This comparison emphasizes the need to consider longitudinal field components and three–dimensional spatial modulation that are absent in simple models. Plane–wave results overestimate the electron energy gain by an order of magnitude. (auth)

27609 THE CALCULATION OF THE FIELD INTEGRAL OR BENDING POWER OF MAGNET COILS. Coupland, J. H. (Science Research Council, Chilton (UK). Rutherford Lab.). Nucl. Instrum. Methods; 117: No. 2, 491–493(15 May 1974).

It is shown how the bending power of an air-cored magnet for a beam of charged particles may be calculated directly without recourse to elliptic integrals and an integration routine. An example of how the field integral varies for a coil pair shows no advantage in choosing a Helmholtz configuration. The method depends on an integral theorem, a proof of which is given in the appendix. (auth)

27610 TWO COMPUTER PROGRAMS FOR RAY-TRACING OF CHARGED PARTICLES WITH SPACE-CHARGE EFFECTS IN VARIABLE EXTERNAL FIELDS. Joel, A.; Tuan, T. T. (Paris-11 Univ., 91–Orsay (France). Inst. de Physique Nucleaire). Nucl. Instrum. Methods; 118: No. 1, 93-98(1 Jun 1974).

Two computer programs have been written in Fortran V for calculating charged particle paths in order to study the extraction conditions of a heavy ion confinement source. These two programs operate on axially symmetric beam and field systems. The first, SPACH, calculates homocharged particle paths. The second, IONEL, calculates the paths of two mixed beams with opposite charges. (auth)

27611 THE MAGNETIC ANALOGUE METHOD AS USED IN THE STUDY OF A CYCLOTRON CENTRAL REGION. Hazewindus, N.; van Nieuwland, J. M.; Faber, J.; Leistra, L. (Philips Gloeilampenfabrieken N.V., Eindhoven (Netherlands)). Nucl. Instrum. Methods; 118: No. 1, 125-134(1 Jun 1974).

The shape of the electric field in a given electrode configuration can be found with the help of a magnetic analogue. In the study of the central particle trajectories of a cyclotron, where a detailed knowledge of the electric accelerating fields is essential, this method appears to be particularly useful. A detailed discussion of the method itself is presented. A computer-controlled apparatus has been built to perform the necessary measurements. The measuring procedures, the subsequent checks and corrections that are applied and the use of the fields in the orbit integrations are reviewed. (auth)

Storage Rings

27612 (AED-CONF-74-093<001) THE PRESENT STATE OF THE DESY STORAGE RING DORIS. Voss, G. E. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). 1974. 11p. (In German). (CONF-740225-(Abstr)). INIS.

From conference on nuclear physics and high energy physics; Hamburg, F. R. Germany (20 Feb 1974).

11 figs.

After a short survey on the construction and the machine parameters of the electron-positron double storage ring DORIS at DESY a report is given on the experience gained during the first six weeks' test run and on the present state of the work. (GE)

27613 (UCID-15694) DIPOLE FIELD IN A TOROIDAL GEOMETRY FOR THE HIGH INTENSITY STORAGE RING. Beal, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jul 1970. 14p. Dep. NTIS $4.00.

As presently envisioned for the High Intensity Storage Ring (HISR), the magnetic guide field will be a superposition of $n = 0$ dipole, bending fields coupled with independent quadrupole focussing fields. Since the HISR is designed for low rigidity particles, approximately 5 MeV kinetic energy electrons, relatively weak field strengths are required. For this reason and also increased flexibility, it was determined to produce these fields without ferrous materials and to use only the appropriate set of current-carrying conductors. Results of numerical calculations pertaining to the dipole field component produced by a set of finite conductors are presented. (auth)

27614 X-RAY PHOTOEMISSION SPECTROSCOPY. Lindau, I.; Pianetta, P.; Doniach, S.; Spicer, W. E. (Stanford Univ., CA). Nature (London); 250: No. 5463, 214-215(19 Jul 1974).

The first x-ray photoemission spectroscopy (XPS) experiments performed at the Stanford Synchrotron Radiation Project, using synchrotron radiation from the Stanford Positron Electron Accelerator Ring (SPEAR) are described. The main object was to study the feasibility of using the favorable properties of synchrotron radiation to achieve high resolution XPS. A resolution of about 0.25 eV was obtained, as against 0.6 to 1.5 eV with commercially available XPS machines. Synchrotron radiation provides a continuous wavelength spectrum which for the SPEAR storage ring extends down to a fraction of an angstrom with considerable intensity. In the photoemission experiments described the sample was irradiated with monochromatic radiation and a kinetic energy analysis performed on the photoemitted electrons. The experimental apparatus employed is described in detail, and its performance is discussed. (UK)

27615 TUNE SHIFTS FOR PARTICLE BEAMS CROSSING AT SMALL ANGLES IN THE LOW-β SECTION OF A STORAGE RING. Keil, E. (European Organization for Nuclear Research, Geneva (Switzerland)); Pellegrini, C. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati); Sessler, A. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Instrum. Methods; 118: No. 1, 165-170(1 Jun 1974).

The linear tune shift of a particle crossing an azimuthally uniform, cylindrically symmetric Gaussian beam is evaluated to first order in the line density, taking into account the variation of the amplitude function β through the crossing region. (auth)

27616 SPIN MOTION IN e^-e^- STORAGE RINGS. Schwitters, R. F. (Stanford Linear Accelerator Center, Calif. (USA)). Nucl. Instrum. Methods; 117: No. 2, 331-337(15 May 1974).

General properties of the spin motion in e^+e^- storage rings are studied in order to determine the conditions where radiative beam polarization is likely to occur. A general first-order theory of depolarization is developed and applied to specific examples of non-resonant depolarization in storage rings. It is found that under many practical conditions radiative beam polarization should occur and therefore the beam polarization will be a significant parameter in high-energy e^+e^- colliding beam experiments. (auth)

Experimental Facilities

Refer also to abstracts 26487, 26941, 26953, and 28447.

27617 (JINR-P13-8079) HIGH INTENSITY PI MESON BEAMS FOR MEDICO-BIOLOGICAL AND PHYSICS STUDIES ON THE LYAP SYNCHROCYCLOTRON OF JINR. Abazov, V. M.; Dzhelepov, V. P.; Kuz'min, E. S.; Molokanov, A. G.; Savchenko, O. V.; Reshetnikov, G. P.; Cherevatenko, E. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 33p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

The method for producing intense π meson beams by means of wide-angle solenoidal lenses with inhomogeneous axially symmetric magnetic fields is described. For π^- mesons with energy around 30 MeV with proton currents of 670 MeV energy and intensity $\approx 10^{12}$ sec^{-1} hitting Cu targets, the following beam parame-

ters were obtained: total intensity $\approx 10^7$ sec^{-1}, current density $\approx 10^5$ $cm^{-2}sec^{-1}$, and stopping density $\approx 5 \times 10^4$ $g^{-1}sec^{-1}$ in water. For beams of π^+ mesons these parameters are higher by a factor of 3.5 to 4. The dose rate in the Bragg peak for beams of π^- is about 3 rad/min. The beams were designed for use in radiobiological and some clinical studies relating to radiation therapy of tumors and in a series of physics studies where high stopping density is important. (tr-auth)

27618 INSTALLATION FOR MEASURING THE ANGULAR ANISOTROPY OF ALPHA DECAY AND FISSION OF ORIENTED ACTINIDE NUCLEI. Gonin, N. N.; Kozlovskii, L. K.; Stavisskii, Yu. Ya.; Tambovtsev, D. I. (Inst. of Physico-Power, Obninsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 42-44(1974).

An installation is described for performing experiments on the measurement of the angular anisotropy of α radiation and the fission of oriented actinide nuclei. A procedure for growing single crystals of uranyl rubidium nitrate and a method for depositing layers of radioactive compounds on them are given. The fission fragments and α particles were recorded by semiconductor detectors that were maintained at a temperature ~25°K. Results are presented of measurements of the anisotropy of α radiation from oriented ^{237}Np nuclei and the emission of fragments as a result of the fission of oriented ^{235}U nuclei by thermal neutrons. (auth)

27619 A RAPID TRANSPORT SYSTEM FOR INTERNAL CYCLOTRON IRRADIATIONS. Bavaria, G.; Kitching, J. E.; Crawford, J. E. (McGill Univ., Montreal, Quebec (Canada). Foster Radiation Lab.). Nucl. Instrum. Methods; 117: No. 2, 317-320(15 May 1974).

A rapid pneumatic transport system used for cyclotron internal irradiations is described. The system permits entry into the cyclotron vacuum tank of a target carrier which is adaptable to solids, liquids or gases. Tests with helium, nitrogen and argon carrier gases were carried out. Transit times of less than 200 ms over an 8 m flight path are comfortably achieved using 15 g target carriers. (auth)

27620 COMMENTS ON "SEPARATED HIGH-ENERGY ELECTRON BEAMS USING SYNCHROTRON RADIATION." White, D.; Erber, T. (Illinois Inst. of Tech., Chicago (USA). Dept. of Physics). Nucl. Instrum. Methods; 118: No. 1, 147-148(1 Jun 1974).

In a recent article Farley et al. proposed the utilization of a magnetic chicane to purify high-energy electron beams. The essential idea is to selectively strip off some of the beam energy by inducing synchrotron radiation (magnetic bremsstrahlung), and then by direct or indirect means exploit the cumulative effects of radiation reaction to produce macroscopic shifts of the electron trajectories. It is pointed out that Farley et al. have underestimated the straggling effects in virtue of an inconsistent semi-classical approximation. (auth)

27621 A METHOD FOR LOCALIZING CELLS OF ENHANCED SURFACE RESISTANCE AND MAGNETIC BREAK-DOWNS IN MULTI-CELL SUPERCONDUCTING RF-CAVITIES. Dammertz, G.; Husson, L.; Lengeler, H.; Rathgeber, E. (Karlsruhe Univ. (TH) (F. R. Germany)). Nucl. Instrum. Methods; 118: No. 1, 141-146(1 Jun 1974).

Localized regions of enhanced surface resistance cause a strong mode dependence of the unloaded quality factors in multi-cell superconducting rf cavities. An analysis of the measured dependence of quality factors on modes at low temperatures allows cells of high surface resistance to be localized. Similarly cells where magnetic break-down occurs may be identified. This analysis is based on the field distributions inside the rf cavity as obtained from simple field-perturbation measurements in a given frequency passband. The study is associated with the construction of the superconducting rf beam separator at CERN. (auth)

27622 ON THE OPTIMIZATION OF THE CAPACITIVE BEAM PICK-OFF. Parkinson, W. C.; Petersen, J. F.; Duplantis, D. C. (Michigan Univ., Ann Arbor (USA). Cyclotron Lab.). Nucl. Instrum. Methods; 117: No. 2, 605-607(15 May 1974).

The use of a capacitive pick-off for generating timing signals from beam pulses is well known. This note describes the system in use with the University of Michigan's time-of-flight facility, and in particular indicates how the signal-to-noise ratio and pulse rise time are optimized. (auth)

27623 NEUTRONS PRODUCED BY 740-MeV PROTONS ON URANIUM. Veeser, L. R.; Fullwood, R. R.; Robba, A. A.; Shunk, E. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 117: No. 2, 509-512(15 May 1974).

The spectrum of neutrons produced by 740-MeV protons striking a thick uranium target has been calculated, and measurements of the low-energy part of the spectrum have been made at two angles to verify calculational procedures. About 25 neutrons are produced per proton. The most probable neutron energy is 0.5 MeV. (auth)

27624 DYNAMIC POLARIZATION OF PROTONS AND DEUTERONS IN SOLID DEUTERIUM HYDRIDE. Solem, J. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 117: No. 2, 477-485(15 May 1974).

Dynamic polarization of protons and deuterons in radiation-damaged solid deuterium hydride containing a small oxygen impurity and the parameters relating to this process have been investigated. The apparatus for preparing a sample from a gas mixture, for retaining it at liquid-helium temperature, for inflicting radiation damage, for observing its EPR and NMR spectra, and for measuring its nuclear- and electron-resonance relaxation times is described. The EPR spectra for atoms and radicals induced by radiation damage are displayed. The relaxation times of the H-atom resonances are shown to be greatly reduced when oxygen is added to the HD gas and a broad resonance appears, which is not present in purer samples and is ascribed to the radical O_2D. The following data are presented for the most successful HD sample: (1) spin-lattice relaxation times for the proton, deuteron, and electron systems; (2) enhancement of proton polarization as a function of microwave power and magnetic field for microwave frequencies of 23.93 GHz and 35.68 GHz at temperatures of 4.2 K and $\approx$ 1.2 K; and (3) enhancement of deuteron polarization as a function of magnetic field for 23.93 GHz at 4.2 K and 1.3 K. A proton polarization of $\approx 3\ ^3/_4\%$ and a deuteron polarization of 0.3-0.4% have been obtained. Proton polarizations of more than 15% might be obtained if the field is raised to 25 kG and both H-atom resonances are used to drive transitions. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

27625 ASTROPHYSICAL PROBLEMS INVOLVING PLASMAS AND PLASMA-SOLID SYSTEMS. I. On the Mechanism and Formation of Loop Prominences. II. Electric Potential on Solid Spheres in a Plasma. III. Physical Conditions in the Meterorite Condensation Environment. IV. Origin of the Ocean. De, B. R. San Diego, CA; University of California (1973). 208p. University Microfilms Order No. 74-9844.

Thesis (Ph. D.).

In Part I, a mechanism is suggested for the formation of loop-type prominences in solar-active regions following flare events. The mechanism is based on the already existing idea of compression of a coronal plasma element resulting in enhanced radiation and consequent cooling of the element. A model is suggested for such a compression based on the concept of a contracting, force-free filamentary structure. This model of compression is shown to be in approximate qualitative and quantitative agreement with observations. In Part II, it is shown that the steady electric potential that develops on a solid body immersed in a plasma is dependent on the dimension of the body relative to the Debye shielding distance in the plasma. In Part III the assumption in many currently popular theories of the meteorite condensation environment that the condensing solids and the ambient gas had the same temperature is examined. This assumption is found to be irreconcilable with our knowledge of space and the fundamental laws of physics. A fresh attempt is made to deduce the physical conditions in the primordial gas at condensation basing on the assumption that the temperature of the solids at condensation was in the range 2000-200°K. The conclusion is that the gas temperature was in the range 3000-10,000°K, perhaps closer to the upper limit. Part IV is a preliminary attempt to understand the problem of the origin of the ocean starting from the assumption of a plasma condensation origin of the materials that now form the earth. Quantitative aspects of the problem are examined. (LBS)

27626 SCATTERING OPERATOR IN THE THEORY OF DISCONTINUOUS MARKOV PROCESSES. Cook, J. M. (Argonne National Lab., IL). J. Math. Anal. Appl.; 47: No. 3, 578-598(Sep 1974).

Modern perturbation theory for linear operators was adapted back to the older classical theory, in particular the century old theory of radiative transfer and its forty year old application to neutron transport theory. An application is made to the astrophysical problem of finding the equilibrium distribution of radiation given the stationary flux incident on a scattering medium occupying some restricted region of space. (JFP)

Cosmic Radiation

Refer also to abstracts 26943, 27773, 27948, 28138, 28166, 28167, and 28293.

27627 EFFECT OF IONIZATION LOSSES ON COSMIC RAY ACCELERATION. Velinov, P. I. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 6, 795-798(1974).

Some general solutions of the equation of the transfer of cosmic rays in a stationary case are examined, recording the effect of ionization losses. (JFP)

27628 OBSERVATION OF PRIMARY ELECTRONS. Nishimura, J. (Tokyo Univ., Tanashi, Japan); Matsuo, M.; Mikumo, E.; Niu, K.; Taira, T. Tokyo Daigaku Uchu Koku Kenkyusho Hokoku; 9: No. 1, 297-304(Mar 1973). (In Japanese).

High energy primary electrons have been measured by using emulsion chambers. The emulsion chambers consist of emulsion plates and metal plates which were stacked alternately. Electron shower was developed in the metal plates, and recorded by the emulsion plates. Exposure of the emulsion chambers was performed once every year since 1968. The cross-section of the detector was 25×20 cm^2. Accuracy of energy determination was checked by observing two gamma-rays produced by the decay of π^0 meson, and was within 10%. The observed intensity ratio (γ/e) of gamma-ray and electrons increased with energy, and a bend of the electron spectrum was shown. Intensity of gamma-ray was measured, and was in good agreement with expected spectrum. Consistency with other experiments was investigated. The observed intensity by Tata group was several times larger than the author's data. This may be due to the ambiguity of energy determination by the Tata group. The results by Chicago group taken with scintillators and Cherenkov counters showed an electron spectrum without bend in logarithmic expression. Error may be due to energy determination or identification of electrons. The results by Goddard group were similar to the author's results. (JA)

27629 LONG LIVED NUCLEUS ^{53}Mn IN THE COSMIC MATERIAL. Nishiizumi, K. (Rikkyo Univ., Tokyo). Uchusen Kenkyu; 17: No. 4, 589-593(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamamatsu, Japan (Dec 1971).

Measurement and analysis of long living ^{53}Mn have been carried out to study cosmic ray. This element can be produced from Fe, especially by the spallation with protons. The history of cosmic-ray and the secular change of cosmic substances can be known from the variation of activity with depth from the surface of meteorites, because its life is long. The measurement of ^{53}Mn can be performed by X-ray counting, mass spectroscopy, or neutron activation analysis. The X-ray accompanying the electron capture process of ^{53}Mn is directly measured with an X-ray counter. The mass spectroscopy is made with a high sensitive mass spectrometer. The ratio of ion beam 53/54 or 53/55 is measured. The activation analysis is to measure the gamma-ray of ^{54}Mn produced by ^{53}Mn(n,γ)^{54}Mn reaction by thermal neutrons. The detection sensitivity is very high, because activity can be increased by activation to 10^4 times as high as original activity. Disturbing reactions ^{55}Mn(n,2n)^{54}Mn or ^{54}Fe(n,ϕ)^{54}Mn by fast neutrons should be reduced as small as possible. At present, the activation analysis is most useful for the purpose. Chemical treatment is usually performed to remove Fe before irradiation and to refine ^{54}Mn after irradiation. A flow-sheet of the chemical treatment is shown. (JA)

27630 EFFECT OF IONIZATION LOSSES ON COSMIC RAY ENERGY IN EXPANDING UNIVERSE. Velinov, P. I. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 3, 333-336(1974).

The changes of energy and energy density of cosmic rays in the process of expansion of the megagalaxy are examined starting with the general equation for the change of energy. (JFP)

27631 CHARGE COMPOSITION OF HIGH ENERGY HEAVY PRIMARY COSMIC RAY NUCLEI. Price, R. D. Washington, DC; Catholic University of America (1974). 175p. University Microfilms Order No. 74-15,995.

Thesis (Ph. D.).

A detailed study of the charge composition of primary cosmic radiation for about 5000 charged nuclei from neon to iron with energies greater than 1.16 GeV/nucleon is presented. Integral flux values of $10 \leq Z \leq 14 = 9.58 \times 10^{-1}$, $15 \leq Z \leq 19 = 1.80 \times 10^{-1}$, $20 \leq Z \leq 23 = 1.15 \times 10^{-1}$, and $24 \leq Z \leq 28 = 2.37 \times 10^{-1}$ particles/m^2-sec-ster for rigidity greater than 4.9 GV and $10 \leq Z \leq 14 = 1.54 \times 10^{0}$, $15 \leq Z \leq 19 = 2.90 \times 10^{-1}$, $20 \leq Z \leq 23 = 2.10 \times 10^{-1}$ and $24 \leq Z \leq 28 = 3.60 \times 10^{-1}$ particles/m^2-sec-ster for rigidity greater than 3.25 GV are reported and compared to other recent measurements at similar geomagnetic latitude. These values are obtained after corrections were made for detector dependences, atmospheric attenuation and solar modulation. New values of 38.5, 32.4, 23.7, and 16.8 g/cm^2 for the attenuation mean free paths in air for these same charge groups are presented. An ionization spectrometer was used to measure the charge spectrum. This detector system consisted of 3 pairs. A charge identification module with 2784 cm^2-ster geometry factor, consisting of two plastic scintillators, one inorganic scintillator (CsI), and one Lucite plastic Cerenkov radiator, a four-grid (2 X-Y pairs) spark chamber to determine each particle's trajectory through the spectrometer, and an energy deposition module consisting of layers of tungsten, and iron interspersed with scintillator for measuring ionization energy loss. This detector measured the charge of a nucleus to an accuracy estimated to be $<\pm 0.7$ of a unit charge. The spectrometer was flown from Holloman Air Force Base, New Mexico (5.0 GV rigidity cutoff) and floated at an altitude of 7.4 g/cm^2 for 16 hours. The observed charge composition was corrected for detector dependences and atmospheric attenuation. This charge distribution, extrapolated back to the source using an exponential path length distribution of pure hydrogen, is consistent with a mean amount of matter of 5 g/cm^2. The results of this propagation back to the source imply the source is predominantly iron, neon (Ne/Fe = 1.44), magnesium (Mg/Fe = 1.68), silicon (Si/Fe = 1.38), with admixtures of sulfur (S/Fe = 0.29), and calcium (Ca/Fe = 0.18), all other elements of charge between $10 \leq Z \leq 26$ being absent at the source and being produced by cosmic ray fragmentation in interstellar hydrogen. This source charge composition is quite similar to the solar system abundances with the exception of neon, sulfur, and argon. It is consistent with the predictions of explosive nucleosynthesis

in highly evolved massive stars, i.e., a supernova origin for energetic heavy cosmic rays. (Diss. Abstr. Int., B)

27632 ISOTROPY OF THE ARRIVAL DIRECTIONS OF ULTRA HIGH ENERGY COSMIC RAYS. Linsley, J.; Watson, A. A. (New Mexico Univ., Albuquerque). Nature (London); 249: No. 5460, 816-817(28 Jun 1974).

It is stated that there has been little success in searches for anisotropies in the arrival directions of ultra high energy cosmic rays, but data on 50 very high energy events, having what is described as an arrival direction "not obviously isotropic" were collected by the Sydney extensive air shower group over 5 years. These data were combined with comparable data from arrays operated in the USA and UK. The arrival directions of 87 showers with primary energies above a few times 10^{19} eV are discussed. It was found that there were no large deviations from an isotropic distribution, and it is concluded that ultra high energy cosmic rays are most likely to come predominantly from extra-galactic sources. There was no evidence of significant clustering of events, nor the existence of point sources of the rays. (UK)

27633 RECENT MEASUREMENTS OF THE MUON COMPONENT OF LARGE COSMIC RAY AIR SHOWERS. Dixon, H. E.; Machin, A. C.; Pickersgill, D. R.; Smith, G. J.; Turver, K. E. (Durham Univ., Eng.). J. Phys., A (London); 7: No. 8, 1010-1016(21 May 1974).

Measurements are reported for the lateral distribution of muons of energy greater than 1 GeV in large air showers. The measurement which was made with the modified Haverah Park spectrograph extends from core distances of 30 to 600 m and is in satisfactory agreement with the results of computer simulations. Data on the differential momentum spectra of muons at core distances of 200 to 600 m in large air showers are reported which are in good agreement with the results of recent computer simulations and do not show the excess of distant energetic muons which featured in earlier measurements. (auth)

27634 UPPER END OF THE OBSERVED COSMIC RAY ENERGY SPECTRUM. Bell, C. J.; Bray, A. D.; David, S. A. (Sydney Univ.). J. Phys., A (London); 7: No. 8, 990-1009(21 May 1974).

The Sydney giant air shower array has been in operation now for approximately five years. The first 10,000 showers observed are analyzed, and a muon size and total energy spectrum are derived. The area time product involved for these data is about 175 km^2 yr, and the threshold energy for these showers is about 10^{17} eV. The detection probability for the array is carefully analyzed by simulated showers, and associated errors are assessed. The resulting energy spectrum is derived using a variety of shower development models from both Sydney and Haverah Park. Latest Monte Carlo and analytical air shower calculations provide the necessary link between the observed number of muons and the primary energy. The Sydney energy spectrum is compared with those from Moscow, Volcano Ranch, Mount Chacaltaya and Haverah Park. No significant change in slope is seen from 10^{17} to about 10^{20} eV, and the data are best summarized by the spectrum $J(>E) = 10^{-12\cdot03\pm0\cdot01}(E/10^{18}\ eV)^{-1\cdot90\pm0\cdot02} m^{-2} s^{-1} sr^{-1}$ for energies in the range $10^{17\cdot25} \leq E \leq 10^{20\cdot25}$ eV. (auth)

27635 PROBLEM OF EVALUATION OF ACCRETION OF EXTRATERRESTRIAL RADIOACTIVE NUCLIDES ON THE EARTH. Sitar, B. (Komenskeho Univ., Bratislava). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; 14: 127-146(1973).

Problems of evaluation of accretion of radioactive nuclides from cosmic space on the Earth are studied. Intensity, energy spectrum, and the chemical composition of the primary cosmic rays are described. Nuclear reactions in the cosmic bodies are divided into spallation reactions, reactions due to secondary particles, and reactions due to low energy solar particles. A dependance of the activity of isotopes on size of cosmic bodies is studied. The influx of some radioactive nuclides in the processes of ablation of meteoroids is evaluated. (auth)

27636 RADIOACTIVE ISOTOPES IN THE LITHOSPHERE. Chrapan, J.; Sitar, B. Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; 14: 147-157(1973). (In Slovak).

Problems of production of radioactive nuclides with cosmic radiation and self-activity in the lithosphere are studied. The neutron flux in the lithosphere is evaluated and the rate of nuclear reaction in the atmosphere and the lithosphere is shown. (auth)

27637 SATELLITE MEASUREMENT OF COSMIC-RAY ABUNDANCES AND SPECTRA IN THE CHARGE RANGE $2 \leq Z \leq 10$. Brown, J. W. Pasadena, CA; California Inst. of Tech. (1974). 116p. University Microfilms Order No. 74-14,264.

Thesis (Ph. D.).

The composition of the nuclear component of the cosmic radiation was under study for some time, because it can yield information concerning the source, propagation, and confinement of cosmic rays within the galaxy. The first comprehensive satellite measurement of cosmic-ray composition and spectra in the charge range $2 \leq Z \leq 10$ using the geomagnetic field as a rigidity analyzer through the entire range of vertical cutoffs is presented. The results indicate that the spectra of all the elements in the observed range are similar, and thus that various ratios of elemental abundances are nearly independent of rigidity over the range $2 \lesssim P \lesssim 15$ GV. Calculations of the propagation of cosmic rays through the interstellar and interplanetary media predict that there should be a variation with rigidity of ratios of various elements, because of the charge-dependent effects of ionization of the interstellar gas by the cosmic rays. The absence of this variation can be explained by assuming a rigidity-dependent confinement of the cosmic rays in the galaxy. From the ratios Be/O and B/O a leakage mean free path decreasing from ~10 g/cm^2 at ~2 GV to ~6-7 g/cm^2 at 10 to 15 GV is obtained, assuming that the interstellar gas is composed of hydrogen and helium in a 10 : 1 ratio. Ratios of other cosmic-ray elements are consistent with such a decreasing path length. The confinement time of the cosmic rays in the galaxy can be estimated from the ratio Be/B, because of the radioactive decay of ^{10}Be to ^{10}B. The data indicate a confinement time of $10^{6\cdot5\pm0\cdot5}$ years, which may be rigidity-dependent. (Diss. Abstr. Int., B)

27638 ENERGY SPECTRUM AND EVIDENCE FOR EXTRAGALACTIC ORIGIN OF DIFFUSE GAMMA-RADIATION IN THE MEV RANGE. Schönfelder, V.; Lichti, G. (Max-Planck-Institut für Extraterrestrische Physik, Garching b. München). Astrophys. J. Lett. 191: No. 1, L1-L5 (1 July 1974).

Results on the diffuse gamma-ray flux between 1.5 and 10 MeV from a balloon-borne double Compton telescope are presented. At 2.5 MeV the diffuse flux exceeds by a factor of 4 a straight-line extrapolation from the X-ray range. The constancy of the gamma counting rate from regions of the sky with galactic latitudes between $b^{II}=0°$ and $b^{II}=-30°$ shows that more than 87 percent of the measured diffuse flux is of extragalactic origin. (auth)

27639 THE EFFECTS OF NONLINEAR TERMS IN COSMIC-RAY DIFFUSION THEORY. Owens, A.J. (Department of Physics, Lake Forest College, Lake Forest, Illinois). Astrophys. J. 191: No. 1, 235-244 (1 July 1974).

A heuristic method of including the effects of nonlinear terms in the derivation of the interaction between cosmic rays and stochastic magnetic fields is presented. The nonlinear terms in the Liouville equation are subsumed into a quasi-phenomenological stochastic scattering term. The resulting theory is similar to quasilinear theory except for the replacement of delta functions in wavenumber with broadened resonance functions. The model indicates that nonlinear terms damp out the initial-value terms, broaden cyclotron resonances, provide scattering for particles with pitch angles near 90°, and set limits on the region of validity of the commonly adopted quasi-linear approximation. An important result is that the ratio $\kappa_\perp/\kappa_\parallel$ of the perpendicular to parallel spatial diffusion coefficient for particles with scattering length much larger than the correlation scale of the magnetic irregularities is equal to the relative mean-squared field fluctuation, $\langle \delta B^2 \rangle / B_0^2 \sim 0.2$. (auth)

27640 PENETRATION OF A LOW-FREQUENCY MAGNETIC WAVE INTO A NEBULA PLASMA. Rose, W.K.; Krall, N.A.; Liewer, P.C. (University of Maryland, Department of Physics and Astronomy, College Park). Astrophys. J. 191: No. 1, 201-205 (1 July 1974).

In this note, we present numerical calculations of the "anomalous" penetration of a low-frequency magnetic wave into a plasma for a parametric range of interest for various astrophysical problems such as the Crab Nebula. When the simplest collective plasma effects are included, the wave can penetrate much farther than the classical skin depth and can produce efficient heating of the plasma ($T_e \sim 1$ MeV). This mechanism may be important for the creation of low-energy cosmic rays. (auth)

27641 COSMIC RAYS AT GROUND LEVEL. Wolfendale, A. W. (ed.). London; Institute of Physics (1973). 240p. ISBS Inc., Portland, Oregon $30.00.

Following a review of the primary cosmic rays incident at the top of the atmosphere, the energy spectra and theoretical background of the main components of the cosmic radiation are covered in some detail, with chapters on extensive air showers, muons, protons and pions, neutrons, muon-neutrinos and electron-neutrinos. There is also an account of the search for quarks, magnetic monopoles and tachyons; and the final chapter describes the neon flashtube, a technique particularly associated with the Durham research group. (MHR)

27642 COMPUTER SIMULATIONS OF COSMIC-RAY SHOWERS. II. Showers Initiated by Heavy Primary Particles. Dixon, H. E.; Turver, K. E.; Waddington, C. J. (Univ. of Durham, Eng.). Proc. Roy. Soc. (London), Ser. A; 339: No. 1617, 157-170(6 Aug 1974).

Computer simulations have been made of large extensive air showers initiated by nuclei heavier than protons. The work forms part of a study of future experiments designed to identify the nature of the energetic primary particles. A model based upon data from nuclear emulsion experiments has been used to represent the break-up of the primary nuclei in collision with air nuclei. Differences in shower characteristics are predicted which are dependent upon the choice of model for the fragmentation of the primary nucleus and its energy. The major cause of fluctuations in the longitudinal development of showers produced by heavy particles is shown to be the pattern of the fragmentation of the incident nucleus. In the absence of a precise knowledge of the high-energy interaction, no parameter has been identified in large showers which, if measurable and averaged over many showers, will reflect strongly the nature of the primary particle. (auth)

27643 COMPUTER SIMULATIONS OF COSMIC-RAY AIR SHOWERS. III. Fluctuations in Shower Development. Dixon, H. E.; Turver, K. E. (Univ. of Durham, Eng.). Proc. Roy. Soc. (London), Ser. A; 339: No. 1617, 171-195(6 Aug 1974).

Detailed studies are made of the fluctuations of a wide range of parameters in computer-simulated extensive air showers in attempts to design experiments which will be sensitive to the mass number of primary cosmic rays of energy 10^{17} to 10^{18} eV. The computational procedures depend heavily on the Monte Carlo technique and the model for the high-energy interactions of nucleons and pions is simple, involving pionization only. The magnitudes of the fluctuations of the electron size, muon sizes and depths of cascade maximum development are determined as a function of the energy and mass of the primary particle. The origin of the fluctuations is identified for showers initiated by primary protons of various energies from studies of the correlations between observable parameters of the showers and measures of the stage of longitudinal development of the electron cascade. The correlation between the different components of air showers and between these components and the longitudinal cascade development are evaluated for over 50 parameters in the showers. Measurable parameters depending little on the longitudinal development of a shower (and hence being good measures of the primary particle energy) and those depending strongly on the cascade development (being indications of the nature of the primary particle) are identified. (auth)

27644 COMPUTER SIMULATIONS OF COSMIC-RAY AIR SHOWERS. I. Average Characteristics of Proton Initiated Showers. Dixon, H. E.; Earnshaw, J. C.; Hook, J. R.; Hough, J. H.; Smith, G. J.; Stephenson, W.; Turver, K. E. (Univ. of Durham, Eng.). Proc. Roy. Soc. (London), Ser. A; 339: No. 1617, 133-155(6 Aug 1974).

Computer simulations have been made of the average characteristics of extensive air showers initiated by primary protons in a wide range of energy. The simulations, which are perhaps unusual in the detailed information available for each shower, have been made as part of a design study for future experiments intended to identify the mass number of energetic primaries. The sensitivity of the data from these simulations to the detail of the adopted model for interactions has been investigated by incorporating the consequences of the results from recent accelerator and cosmic ray experiments. The simulations have been made by means of a variety of computational techniques; in most simulations a simple representation of the interaction of high-energy nucleons and pions has been employed which is characterized by accounting well for presently available experimental data on large air showers. It is concluded that the treatment of showers, although derived with a simple model for interactions, may be usefully employed to study the fluctuations in air-shower development. (auth)

27645 GAMMA ASTRONOMY EXPERIMENT ABOARD THE TD1 SATELLITE MEETING OF COSPAR. Koechlin, Y. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 187, 29-33(Dec 1973). (In French).

From meeting of COSPAR; Konstanz, Ger. (26 May 1973).

Experiment S 133, shared by SEP of Saclay, Max Planck Institut of Munich, and Physics Institute of Milan, recorded celestial gamma rays from an all-sky scan during the period March-October 1972. The spark chamber experiment records electron pairs from converted gamma rays with a geometry factor of about 20% above 150 MeV. It starts to record gamma rays above about 20 MeV. The sky coverage averaged over the months of operation was about 50%. The experiment is again operational since February 1973 for a second all-sky scan. Analysis of data are in progress and the technical Saclay experiment is given. (FR)

27646 MEASUREMENT OF THE PRIMARY COSMIC-RAY ELECTRON SPECTRUM FROM 6 GeV TO 100 GeV. Meegan, C. A. College Park, MD; Univ. of Maryland (1973). 221p. University Microfilms Order No. 74-17,054.

Thesis (Ph.D.).

The differential energy spectrum of primary cosmic-ray electrons was measured from 6 to 100 GeV. The detector was a Geiger tube hodoscope which incorporates 8 trays of Geiger tubes, 10 scintillation counters and 31.9 radiation lengths of lead. The Geiger tubes provide triggering and trajectory information. The top two scintillators measure dE/dx of incident particles, while the other eight scintillators sample the electron showers at various depths in the lead adsorber. The geometric factor of the detector is 352 cm^2 ster. Detailed characteristics of electron showers were determined for energies up to 9 GeV by a calibration of the hodoscope at the Cornell Electron Synchrotron. The hodoscope was exposed to primary cosmic rays on three balloon flights for a total exposure of 3500 ± 100 m^2 ster sec at an average altitude of 4.7 mbar. Electrons were identified and their energies were determined by performing a least squares fit of the observed pulse heights in each event to the pulse heights expected for electrons. In this way, each event was assigned an energy and a goodness-of-fit parameter S_{min}. Electrons were distinguished from interacting nuclei as a clearly resolved peak in a plot of number of events vs. S_{min}. The primary electron spectrum thus obtained can be expressed as a single power law between 6 and 100 GeV. The measured primary intensity is given by $dJ/dE = 800\ E^{-3.4 \pm .1}$, where E is energy in GeV. The primary electron spectrum obtained here is significantly steeper than the spectra of cosmic ray nuclei. The interpretation of this difference is that the electron spectrum above 10 GeV was steepened by one power of energy due to inverse Compton and synchrotron energy loss. In this model, an average lifetime of greater than 30 million years is required. Since the abundances of Li, Be, and B indicate that cosmic rays spend an average of only a few million years in the disc, the results of this experiment imply that the confinement volume for cosmic rays is the galactic halo. The energy spectrum of atmospheric secondary electrons at sea level was also determined. The measured sea level intensity between 0.56 and 18 GeV is given by $dJ/dE = 1.1\ E^{-2.8 \pm .1}$, in agreement with calculated and previously measured values. Upper limits to the anisotropy of cosmic-ray electrons were also obtained. (Diss. Abstr. Int., B)

27647 INTERPRETATION OF THE CHEMICAL COMPOSITION OF VERY HIGH ENERGY COSMIC RAYS. Cesarsky, C. J.; Audouze, J. (California Inst. of Tech., Pasadena (USA)). Astron. Astrophys.; 30: No. 1, 119-126(Jan 1974).

4 figs.; 1 tab.; 26 refs.

The presently available data on the chemical composition of the high energy cosmic rays have been analyzed in the framework of the most widely used theory of cosmic ray propagation. It appears from this analysis that the mean path length of the cosmic rays in the Galaxy decreases when the energy increases, and the sources of high energy cosmic rays are richer in Fe relative to the M(C + O) elements than the sources of lower energy cosmic rays. Other hypotheses on the sources of cosmic rays are also discussed. In Appendix A the dependence of the mean path length on the helium content of the interstellar gas is studied, while the effects of a possible variation of the nuclear cross sections with the energy are considered in Appendix B. (auth)

Stars

Refer also to abstracts 27631, 28438, and 28627.

27648 (AD-773309) TIME VARIATIONS IN THE OH MICROWAVE AND INFRARED EMISSION FROM LATE TYPE STARS. Harvey, P. M.; Bechis, K. P.; Wilson, W. J.; Ball, J. A. (Aerospace Corp., El Segundo, Calif. (USA)). 1 Dec 1973. Contract F04701-73-C-0074. 82p. (SAMSO-TR-73-401). NTIS $4.00.

The OH microwave and infrared variability of 14 OH/IR stars were studied. Many of the sources show periodic flux variations between 1 and 10 micrometers and in the 1612-MHz OH lines with no appreciable phase difference between the infrared and microwave. The best explanation for this correlation seems to be that the OH masers are radiatively pumped. In at least two sources the 1665- and 1667-MHz variations are significantly greater and more random than in the 1612-MHz sources. These data are not of sufficient quality to determine if the 1665/1667-MHz and infrared variations are significantly correlated. A correlation does exist between the period of variation, the amplitude of variation at 2.2 micrometers, the (3.5 micrometers)−(10 micrometers) color index, the separation in velocity of the two OH emission features, and the existence of 1.35 cm H_2O emission in the Mira type stars observed. No evidence is seen in the infrared for periodic

variations of the color temperature of the circumstellar shells which are believed to surround many of these stars. (auth)

27649 VARIATIONS OF THE EMISSION LINE PROFILES IN THE 06ef STAR LAMBDA CEPHEI. Conti, P.S.; Frost, S.A. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards). Astrophys. J. Lett. 190: No. 3, L137-L140 (15 June 1974).

Dramatic variations in the emission line profiles of Hα and λ4686 He II from eight consecutive nights of observations are reported. Other absorption lines appear to be constant during this time. Also described is an innovative computer method for obtaining line profiles from spectrograms. (auth)

27650 M SUPERGIANTS IN THE LARGE MAGELLANIC CLOUD. Humphreys, R.M. (University of Minnesota, Minneapolis). Astrophys. J. Lett. 190: No. 3, L133-L135 (15 June 1974).

Eight red stars in the Large Magellanic Cloud have been classified as high-luminosity M supergiants. Their absolute visual magnitudes range from −7.7 to −6.6 mag. These are the first extragalactic M supergiants to be recognized by MK spectral classification. (auth)

27651 SHORT-DURATION RADIO FLARES OF UV CETI STARS. Spangler, S.R.; Shawhan, S.D.; Rankin, J.M. (Department of Physics and Astronomy, The University of Iowa, Iowa City). Astrophys. J. Lett. 190: No. 3, L129-L131 (15 June 1974).

The UV Ceti-type stars YZ Canis Minoris, AD Leonis, Wolf 424, and V371 Orionis were monitored with the Arecibo radio telescope at meter wavelengths. A total of 26 flares were recorded on YZ CMi, AD Leo, and Wolf 424. The observed flares had shorter durations and smaller amplitudes than those previously reported in the literature. Rates of radio-flare detection are similar to those found optically. (auth)

27652 OPTICAL OBSERVATIONS OF HD 77581 AND A MODEL FOR THE SYSTEM HD 77581-2U 0900-40. Petro, L.D.; Hiltner, W.A. (Department of Astronomy, University of Michigan). Astrophys. J. 190: No. 3, 661-666 (15 June 1974).

From an analysis of photometric observations a more precise value of the period of HD 77581-2U 0900-40 has been determined, namely, 8.972(1) days. From an analysis of the photometric, spectroscopic, and X-ray eclipse observations the mass ratio is approximately 0.08 and sin i=1.0. Evidence for an elliptical orbit and further evidence for mass loss are presented. (auth)

27653 MODELS OF ASYMPTOTIC-GIANT-BRANCH STARS. Wood, P.R. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University). Astrophys. J. 190: No. 3, 609-630 (15 June 1974).

The static structure and dynamical behavior of the envelopes of four 0.9 $M_\odot$ asymptotic-giant-branch stars are described. It is found that in a model of luminosity $\log L/L_\odot = 3.42$ the envelope pulsates steadily in the first-overtone mode. The full-amplitude pulsational properties of this model agree well with those of a Mira variable of the same period. Three more-luminous models ($\log L/L_\odot = 3.60$, 3.85, and 4.14) all pulsate in the fundamental mode while simultaneously undergoing violent relaxation oscillations. Mass loss occurs from the models of luminosity $\log L/L_\odot = 3.60$ and 4.14. The models which execute envelope relaxation oscillations have properties which resemble those of some of the symbiotic stars. A distinct outward-moving shell which forms in the two most luminous models suggests a connection with planetary-nebula ejection. (auth)

27654 ON THE BEAT PHENOMENON IN THE BETA CEPHEI STARS. Deupree, R.G. (David Dunlap Observatory, Richmond Hill, Ontario). Astrophys. J. 190: No. 3, 631-636 (15 June 1974).

The hypothesis of the degeneracy between a radial and a nonradial mode as an explanation of the beat phenomenon in the β Cephei stars is examined by means of a linear, adiabatic pulsation analysis using realistic stellar models. The results are in the form of theoretical values of θ_{eff}, log g (to eliminate bolometric corrections), the radial pulsation period, and the period difference between the two periods presumed to cause the beats. These results are compared with observational equivalents, and the agreement for a number of the β Cephei stars showing this effect gives support to this hypothesis. On the assumption that this is the correct explanation of the beats, some conclusions may be drawn regarding the properties of the β Cephei stars. (auth)

27655 COHERENT OSCILLATIONS IN UX URSAE MAJORIS. Nather, R.E.; Robinson, E.L. (McDonald Observatory and The University of Texas at Austin). Astrophys. J. 190: No. 3, 637-651 (15 June 1974).

Rapid oscillations appeared in the light curve of UX UMa and were studied from 1973 March 3 through 8, during which time they varied smoothly in period from 30.03 to 28.54 s, and exhibited a rapid phase shift of −360° associated with each eclipse. The phase shift can be understood in terms of nonradial pulsations with l=2 and m=−2 or +2. Numerical examples demonstrate that the model provides a qualitative agreement with the observed phase shift in UX UMa, and with the similar but positive 360° phase of the 71-s periodicity in DQ Her. The oscillations are present throughout the orbital cycle and are essentially undiminished in amplitude even during eclipse. The eclipse curve is shown to be composite, with the oscillations associated with the primary; their phase change permits the centerline of this object to be identified and separated from the second object eclipsed, which is identified as the "bright spot" on the disk of gas surrounding the oscillating star. It is proposed that the blue star in UX UMa is a pulsating white dwarf. The apparent photosphere of the blue star lies not at the surface of the white dwarf but instead lies in the optically thick disk of gas rotating around the white dwarf, and is at some distance from its surface. (auth)

27656 DO OB RUNAWAYS HAVE COLLAPSED COMPANIONS? Bekenstein, J.D. (Center for Relativity Theory, The University of Texas at Austin, Austin, Texas 78712); Bowers, R.L. Astrophys. J. 190: No. 3, 653-659 (15 June 1974).

We present a list of 55 OB runaway candidates. Assuming the conventional explanation of a runaway in terms of a supernova explosion in a close binary, we use considerations of mass exchange to place an upper bound on the mass of an hypothetical collapsed companion for some of the candidates. In 11 cases the available data are not inconsistent with the presence of a companion massive enough to be a black hole. We suggest observations to test the model, to establish better bounds on remnant masses, and (possibly) to detect collapsed companions. (auth)

27657 SOME RECENT RESULTS FROM GALACTIC AND STELLAR EVOLUTION THEORY. Talbot, R.J. Jr. (Department of Space Physics and Astronomy, Rice University, Houston, Texas); Arnett, W.D. Astrophys. J. 190: No. 3, 605-608 (15 June 1974).

Recent progress in stellar and galactic evolution theory give excellent agreement between observational abundances and the theoretical yields for elements heavier than helium. This includes the secondary production of ^{14}N and the variation of N/O over the face of M101 which was observed by Searle. (auth)

27658 X-RAY IONIZATION CROSS-SECTIONS, AND IONIZATION EQUILIBRIUM EQUATIONS MODIFIED BY AUGER TRANSITIONS. Weisheit, J.C. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Astrophys. J. 190: No. 3, 735-740 (15 June 1974).

Approximate subshell cross-sections for ionization by photons of energy $5000\ eV \geq E \geq 100\ eV$ have been computed for all ions of C, N, O, Ne, Mg, Al, Si, and S. Each subshell cross-section τ has been fitted to a simple power-law form, $\tau \propto E^{-\theta}$, and the fitting parameters are tabulated. In addition, the Auger transitions that follow inner-shell ionizations are considered in detail, and modified ionization equilibrium equations are derived for elements of nuclear charge $Z \leq 18$. (auth)

27659 ENERGY SPECTRUM OF HYDROGEN-LIKE ATOMS IN A STRONG MAGNETIC FIELD. Surmelian, G.L.; O'Connell, R.F. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). Astrophys. J. 190: No. 3, 741-742 (15 June 1974).

An expression for the energy spectrum of hydrogen-like atoms in strong magnetic fields is derived in terms of the energy spectrum of hydrogen. The development of a parametric expression for the latter is thus motivated. We present such an expression for the ground-state energy of hydrogen in magnetic fields $B \simeq 10^7 - 10^{12}$ gauss, obtained by least-squares fittings of numerical results obtained previously from a variational calculation. (auth)

27660 TOROIDAL FIGURES OF EQUILIBRIUM. Wong, C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Astrophys. J. 190: No. 3, 675-694 (15 June 1974).

A rotating mass in the form of a torus allows an effective balance between the gravitational attraction and the force due to centrifugal acceleration, when the angular momentum is very large. Attention is therefore fixed on a toroidal mass idealized for simplicity to be homogeneous, incompressible, and rotating uniformly about the central symmetry axis. The toroidal figures of equilibrium are determined in a self-consistent manner for various values of the angular momentum. The set of toroidal figures of equilibrium forms a sequence that begins when the angular momentum L is given by $(25/12)(4\pi/3)^{1/3} L^2 \rho^{1/3}/GM^{10/3} = 0.8437(5)$. The corresponding Maclaurin spheroid having such a critical angular momentum would have an eccentricity e=0.9817(1). The toroidal sequence and the Maclaurin sequence do not join on each other directly but are probably connected by an unstable sequence with intermediate shapes. The properties of the toroidal sequence under beaded displacements, in which the toroid becomes thicker in some meridians but thinner in others, are studied for two cases in which the flow pattern is assumed known. Stability against these displacements is found to depend on the flow pattern which is affected by the dissipative mechanism. Whether toroidal figures play any role in the evolution of astrophysical objects is examined from an observational point of view. A hypothesis of toroidal formation and breakup in galaxies and pre-main-sequence stars is postulated and compared with observations. (auth)

27661 ON THE C_2, CN, AND CO INDICES OF CARBON STARS. Fay; T.D. Jr. (Louisiana State University Observatory, Baton Rouge, Louisiana 70803). Astrophys. J. 190: No. 3, 597-599 (15 June 1974).

The CO, CN, and C_2 photometric indices of carbon stars can be simply related by plotting log CN/C_2 versus log CO/C_2. Our relation appears consistent with the hypothesis that carbon stars have only small changes in N/O ratio. Carbon stars that are Mira variables fall below our relation for non–Miras. The lower CN indices of the Miras may be related to an increase in the strength of their 11 μ Si_3N_4 peaks. Carbon stars of type J (^{13}C rich) fall above our relation, suggesting that they have slightly larger N/O ratios that non–J stars. (auth)

27662 RESOLUTION OF THE PRASEODYMIUM ABUNDANCE ANOMALY IN THE Ba II STARS. Allen, M.S.; Cowley, C.R. (University of Michigan, Ann Arbor). Astrophys. J. 190: No. 3, 601-604 (15 June 1974).

Previous abundance analyses of Ba II stars have usually yielded large excesses of praseodymium over its rare–earth neighbors. Several of these analyses have been revised to include the effect of hyperfine structure in the spectrum of Pr II. The revised abundances show excellent agreement with predictions of the s–process. (auth)

27663 THE HOLMIUM Ap STAR HD 51418. Jones, T.J.; Wolff, S.C.; Bonsack, W.K. (Institute for Astronomy, University of Hawaii). Astrophys. J. 190: No. 3, 579-583 (15 June 1974).

The peculiar A star HD 51418 differs from other Ap–type stars in that its spectrum is dominated by lines of the heavy rare earths, including particularly holmium and dysprosium. In this respect, the spectrum of HD 51418 closely resembles that of HD 101065 (Przybylski's star). The magnetic field of HD 51418 varies from +750 to −200 gauss, and magnetic minimum coincides in phase with rare–earth minimum and with minimum light. The observed radial velocity variations give strong evidence that the spectrum variations can be accounted for by the oblique rotator model. (auth)

27664 OBSERVATIONS OF THE PROFILE OF THE Ca II INFRARED TRIPLET LINE λ8498 IN LATE–TYPE STARS. Anderson, C.M. (Washburn Observatory, University of Wisconsin, Madison). Astrophys. J. 190: No. 3, 585-590 (15 June 1974).

The profiles of the Ca II infrared triplet in λ8498, observed at a resolution (FWHM) of 0.28 Å for 28 stars of spectral type F8 and later, are presented. Although there does not appear to be any correlation of line parameters with the strength of the emission observed in the H– and K–lines, the profile is clearly sensitive to the luminosity of the star. (auth)

27665 THE CARBON MONOXIDE BAND STRENGTH AND $^{12}C/^{13}C$ RATIO IN K GIANTS. Ridgway, S.T. (Department of Physics and Department of Earth and Space Sciences, State University of New York at Stony Brook). Astrophys. J. 190: No. 3, 591-596 (15 June 1974).

The first overtone vibration–rotation bands of CO have been studied in the spectra of 15 giants, G8–K5. CN–strong stars are found to be characterized by CO band–strength excess, and it is argued that a true abundance difference must be responsible. Spectral synthesis is employed to deduce a $^{12}C/^{13}C$ ratio of about 10 for four normal K giants and α Boo. The normal giants appear to have a carbon abundance near the solar value. The CN–strong, super–metal–rich α Ser is distinguished by a relative ^{13}C deficiency. (auth)

27666 INTERSTELLAR LINES IN THE ULTRAVIOLET SPECTRUM OF DELTA SCORPII. Smith, A.M. (Laboratory for Optical Astronomy, Goddard Space Flight, Greenbelt, Maryland). Astrophys. J. 190: No. 3, 565-571 (15 June 1974).

Data are presented for interstellar lines arising in C^0, C^+, N^0, O^0, Al^+, Si^+, and Fe^+ which have been observed in an ultraviolet spectrogram of δ Sco obtained by rocket techniques. Excepting the iron transition, these lines are analyzed to yield column densities from which abundances relative to atomic hydrogen are determined. Compared with solar abundances, silicon is slightly overabundant by a factor of 1.6 and the remaining species are underabundant by factors of 1.8–8.6. An analysis of the observed relative population of the carbon atom fine–structure levels combined with a mean cloud temperature of 47°K determined previously from the interstellar H_2 spectrum permits an estimate of the mean cloud density equal to 250 cm^{-3}. Using the measured column densities of neutral and singly ionized carbon an average ratio of the electron density to hydrogen atom density in the clouds equal to 2.1×10^{-4} cm^{-3} is derived. (auth)

27667 FOUR–COLOR OBSERVATIONS OF EARLY–TYPE STARS. IV. SOUCH GALACTIC POLE. Philip, A.G.D. (State University of New York at Albany and Dudley Observatory). Astrophys. J. 190: No. 3, 573-578 (15 June 1974).

Forty–eight B– and A–type stars with visual apparent magnitudes from 4.3 to 14.5 have been measured photoelectrically in the Strömgren four–color system. In a 34 square degree region surrounding the South Galactic Pole (from the list of Philip and Sanduleak), all stars classified as spectral type A5 and earlier were measured. Of the 26 early–type stars in this area, 15 were classified as members of Population I, four were Population II, four were an intermediate polulation, two were B–type, and one was peculiar. In agreement with a similar study at the North Galactic Pole (Philip), Population I stars were found at large distances from the galactic plane, but were in the minority (three out of 10) relative to the evolved stars. The color excess in the central 34 square degree region is $E_{B-V}=0.02$. (auth)

27668 CROSS SECTIONS FOR He II EXCITATION BY ELECTRON COLLISION. Samoilov, V.P.; Smirnov, Y.M.; Starikova, G.S. (Moscow Power Engineering Institute). Sov. Astron.–AJ 17: No. 6, 839-839 (May 1974).

Collisional–excitation cross sections are measured for four He II lines, with electron energies ranging from threshold to 400 eV. The observed lines are in the 2500–4700 Å region. The maximum cross section has a power–law dependence on the principal quantum number n of the upper level, with an exponent–4.2 for the 3d $^2D-nf^2P^0$ series of He II. (auth)

27669 EVOLUTION OF ORBITAL ELEMENTS OF CLOSE BINARY SYSTEMS. Radzievskii, V.V.; Surkova, L.P. (M. Gor'kii State Pedagogical Institute). Sov. Astron.–AJ 17: No. 6, 757-762 (May 1974).

It is shown that the application of the method of bipolar moments allows one to obtain very simply the exact solution of differential equations of motion of two bodies of variable mass or to facilitate a qualitative analysis of the behavior of the osculating orbital elements of these bodies. The incorrectness of the method by which the adiabatic invariants of Jeans, as well as other invariants in the mechanics of two bodies of variable mass, were obtained is explained. The arbitrary choice of a mass emission function is shown to be inadmissible for the given form of the differential equations of motion. Critical remarks are addressed to the theory of "pure" flowing over of material between components which interprets the observed secular changes in the periods of close binary systems. A new mechanism is examined for abrupt changes in period based on a sudden change in the axial moment of inertia of one of the components through its collapse or expansion. The correlation resulting from this mechanism is confirmed by observational data. (auth)

27670 SPECTROPHOTOMETRY OF M–TYPE GIANT STARS. Komarov, N.S.; Medvedev, Y.A.; Mishenina, T.V. (Astonomical Observatory, Odessa State University). Sov. Astron.–AJ 17: No. 6, 753-756 (May 1974).

The article presents an analysis of 22 stellar spectrograms obtained with the 122–cm reflector of the Crimean Astrophysical Observatory. By the curve–of–growth method, physical parameters have been found for the atmospheres of seven red giants: R Lyr, β Peg, μ Gem, η Gem, ρ Per, VZ Cam, and β And. The relative chemical composition of the atmospheres of these stars has been determined. (auth)

27671 INTERFEROMETRY AND SPECTROSCOPY OF THE PLANETAY NEBULA NGC 2474–75. Doroshenko, V.T.; Kolotilov, E.A. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 17: No. 6, 749-752 (May 1974).

Interferometric observations in the Hα and [N II] lines and spectroscopic observations of the planetary nebula NGC 2474–75 were carried out in January–March 1972, with the 125–cm Crimean reflector of the Shternberg Institute, equipped with a Fabry–Perot etalon, contact image converter, and grating spectrograph. The nebula is found to have an electron temperature $T_e=14{,}000\pm2000$°K and an electron density $n_e=350-700$ cm^{-3}. The abundance and degree of ionization are estimated for O III, N II, and S II. Somewhat different expansion velocities are observed in different parts of the nebula, with an average value of ≃35 km/sec. The heliocentric radial velocity at the center of the nebula is $V_r=-89\pm5$ km/sec. (auth)

27672 SUPERNOVA OUTBURSTS AND THE FORMATION OF RELATIVISTIC OBJECTS. II. Guseinov, O.K.; Kasumov, F.K. (Shemakha Astrophysical Observatory, Academy of Sciences of the Azerbaidzhan SSR). Sov. Astron.–AJ 17: No. 6, 737-740 (May 1974).

From a survey of the space distribution, age, flux density, spectrum, and other properties of supernova remnants and pulsars, and from reports of searches for pulsars in supernova remnants, the formation rate of pulsars radiating in the direction toward the earth is found to be half the frequency of supernova outbursts. Directivity of pulsar radiation would render no more than half of all pulsars unobservable. The most distant pulsar is the one in the Crab Nebula. (auth)

27673 PHYSICAL CHARACTERISTICS OF TYPE I SUPERNOVA ENVELOPES DURING THE INITIAL EXPANSION PHASE. III. ABUNDANCE OF LIGHT ELEMENTS: H, He, C, N, AND O. Mustel', E.R. (Astronomical Council, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 6, 711-716 (May 1974).

The relative abundance of H, He, C, N, and O atoms in type I supernova envelopes is discussed. The spectral energy distribution obtained by Kirshner et al. for supernovae 1972e, 1971i, and 1972l is used. First all absorption features in the spectra of these supernovae are identified on the basis of the general analysis given in Paper II for the time development of type I supernova spectra. The following conclusions

are drawn: a) All the spectra, especially for SN 1972e and 1971i, are well explained by the absorption hypothesis; for each supernova the Doppler factor $\kappa=\Delta\lambda/\lambda$ remains constant throughout the observed spectrum. b) Certain strong absorption lines belong to He I (a blend of He I D_3 and Na I $D_{1,2}$, λλ 7065 and 10,830, and other lines). c) In the C, N, O group the only definite identifications are the strong λλ 10,113, 9393, 8212 N I absorption lines and possibly N II multiplet No. 3; other prominent N II lines would overlap lines and blends of different elements. d) Identification of C I and O I absorption lines is not only uncertain but would entail various difficulties. e) Confirming the result of Paper II, there is no trace of Balmer absorption or emission lines in the spectra of these supernovae; the abundance of H atoms in type I supernova envelopes is anomalously low, considerably below the N abundance. (auth)

27674 TV INVESTIGATION OF ULTRASHORT PERIODIC OPTICAL RADIATION SOURCES. Abramenko, A. N.; Gollandskii, O. P.; Prokof'eva, V. V. Izv. Krym. Astrofiz. Observ.; 49: 89-97(1974). (In Russian).

A TV method for search and study of optical radiation sources having ultrashort periodic light variations (with periods from 0.001 to 1 sec) is suggested. Using this method it is possible to observe and to photograph on the TV screen the object to be studied being resolved into a set of n phases of its light variation period. The number n can be made large enough. A functional scheme is given which enables to search and to study light sources with known (pulsars) as well as unknown period of light variation. The method was checked by study of the pulsar NP 0532 as well as by study of a laboratory variable light source. Preliminary results on search for an ultrashort periodic light source in the vicinity of the X-ray source Cyg X-1 are given. Photometric treatment of photographs taken on July 30, 1971 showed that there is a star of 16,5 vis. magnitude suspected to be variable with the period of 0.0745 sec. (auth)

27675 PHOTOELECTRIC OBSERVATIONS OF CH CYG IN 1969. Belyakina, T. S.; Brodskaya, E. S. Izv. Krym. Astrofiz. Observ.; 49: 58-64(1974). (In Russian).

During the period from August 25 to August 31, 1969 simultaneous photoelectric observations of CH Cyg were carried out using 70-cm and 33-cm reflectors. Continuous records of CH Cyg light in regions of λλ5120–5320 Å, 4155–4280 Å and 3350–3650 Å were made with a photoelectric spectrocolorimeter mounted at Cassegrain focus of the 70-cm reflector. Observations in the photometric system similar to UBV with the 33-cm-reflector secured the check of atmospheric extinction and constancy of comparison stars. It was shown that the intensity of the UV-continuum on August 27–28, 1969 was similar, its maximum value observed in August 1968. From August 27 to August 31 considerable decrease of its intensity was noted. The later photometric observations showed considerable reddening of the star on September 30 and October 6, 1969. A two-colour diagram analysis of all photoelectric observations available for the period 1967–1969 led to conclusion that the changes of CH Cyg B–V and U–B colours are similar to that of symbiotic stars. Assuming that CH Cyg is the binary star the luminosity of its components have been estimated. Maximum V brightness of the cold component was to be about 6.6m, and minimum V brightness of the hot one–about 11.7m. (auth)

27676 SPECTRAL AND PHOTOELECTRIC OBSERVATIONS OF THE FLARE STAR EQ PEG. Kulaprova, A. N.; Shakhovskaya, N. I. Izv. Krym. Astrofiz. Observ.; 49: 65-72(1974). (In Russian).

According to photoelectric patrol of combined light of the EQ Peg (Gl 896 AB) components it has been found that the flare activity of this star is 5–10 times less than that of the most active flare stars UV Cet, YZ CMi, EV Lac, AD Leo. The variability of Ca II emission in the spectra of the brightest component (Gl 896 A) gave some indications on the possible flare activity of this component. That is confirmed by simultaneous photoelectric and spectroscopic observations. This fact forces us to abandon the existent opinion that only faintest components of UV Cet type binaries are flare stars. (auth)

27677 NATURE OF BY DRA VARIABILITY. Gershberg, R. E.; Shakhovskaya, N. I. Izv. Krym. Astrofiz. Observ.; 49: 73-79(1974). (In Russian).

Emission lines in spectra of red dwarf star BY Dra were noticeably weaker in 1968–1971 compared to 1965; the spottedness of stellar surface was decreasing during this period. All known quick flares have taken place close to minimum brightness phase. Flare energy and occurrence are similar to flares of AD Leo that is a classical UV Cet-type star. These facts show that all observational features of BY Dra can be described within framework of a spectral binary model with a strong UV Cet-type activity on the main component surface. Alternative Evans' hypothesis on the existence of a dust cloud to explain photometric features of the CC Eri star related to BY Dra is considered. It is shown that particles of necessary parameters are not able to be captured from interstellar medium and strong stellar wind may lay obstacles to formation of such particles in circumstellar space. (auth)

27678 SPECTRAL DUPLICITY OF DELTA CEP C. Vitrichenko, E. A.; Marsakov, V. A.; Kholopov, P. N.; Tsarevskii, G. S. Izv. Krym. Astrofiz. Observ.; 49: 80-85(1974). (In Russian).

The sixty five radial velocity measurements of δ Cep C (blue visual companion of cepheid δ Cep A) have been obtained. The evidences are given that δ Cep C is spectral binary. The most probable periods of system are: 0.89986d and 0.46458d. In both cases the γ-velocity of δ Cep C is in good agreement with mean velocity of δ Cep A. It is a strong argument on their physical connection. The secondary component of δ Cep C may have very low mass (near 0.1 solar mass or less). (auth)

27679 PLASMA NEUTRINO PROCESS $\gamma + \nu + \bar{\nu}$. Abak, M. (Univ. of Sussex, Brighton, Eng.). Lett. Nuovo Cim.; 10: No. 8, 313-316(22 Jun 1974).

The role of plasma neutrino emission in the neutrino escape mechanism from dense stars is considered. The expression of the matrix elements for the energy loss rates given by Tsytovich is modified by including the dielectric effect of the plasma on the photon. (LBS)

27680 OAO-2 OBSERVATIONS OF THE NEAR ULTRAVIOLET EXTINCTION FEATURE. Savage, B. D. (Washburn Observatory, Madison, WI). Int. Astron. Union Symp.; No. 52, 21-27(1973).

From conference on interstellar dust and related topics; Albany, NY (29 May 1972).

OAO-2 near UV spectral scans of 75 early-type stars have been examined for evidence of the UV extinction bump. The bump has been detected in 40 of these stars. The position of the maximum of the bump is within plus or minus 40 A of 2175 A in all cases. A color excess between the wavelengths 2175 A and 3500 A was determined for all 40 stars. This color excess, which is a measure of the bump strength, correlates very well with E(B-V) except for stars associated with nebulosity. (auth)

27681 OSCILLATIONS OF THE ELASTIC PARAMETERS OF COMPRESSED MATTER. Kirzhnits, D. A.; Shpatakovskaya, G. V. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1828-1843(May 1974). (In Russian).

A theory of oscillations of elastic parameters of compressed matter involving changes in the composition or pressure (volume) of the matter is developed on basis of an extension of the Thomas–Fermi method previously proposed, which can be employed for describing shell effects. It is shown that oscillation effects arise in strongly compressed matter as a result of the energy levels successively going over to the continuous spectrum. The oscillations can be reduced to a set of phase transitions of the first kind with the characteristic pressure plateau, atomic volume discontinuities, etc. The oscillation energy of an uncompressed atom is estimated. Applications to the theory of white dwarfs are discussed. (auth)

27682 CHEMICAL COMPOSITION OF UPPER MAIN SEQUENCE STARS. I. Sirius. Shibata, Y. (Tohoku Univ., Sendai); Takeuti, M. Sci. Rep. Tohoku Univ., First Ser.; 56: No. 2, 62-72(Sep 1973).

Stellar evolutions of 2.2 solar masses in the hydrogen-burning phase are computed using the Henyey code for various chemical compositions, and the results are compared to observational data of Sirius A. It is shown that the helium content of Sirius A is normal and the metal content is slightly high in comparison with the Sun for the age of the Sirius system, which is estimated from the cooling time of Sirius B in the white dwarf stage with neutrino process. The result is in accord with the abundance analysis of the spectrum of Sirius A. Influences of observational errors in data and internal errors in the method are briefly discussed. (auth)

27683 REDISTRIBUTION EFFECTS ON LINE FORMATION IN MOVING STELLAR ATMOSPHERES. I. The Isotropic Redistribution Function $R_{I\text{-}A}(x',x;v)$. Vardavas, I. M. (Univ. of Sydney). J. Quant. Spectrosc. Radiative Transfer; 14: No. 9, 909-918(Sep 1974).

The effects of photon frequency redistribution in semi-infinite and slab, differentially-moving atmospheres are examined for the case of pure Doppler broadening as described by the angle-averaged redistribution function. Results are obtained for the frequency dependent non-LTE line source functions and their corresponding emergent line intensities. These emergent line intensities are compared with those obtained assuming complete

redistribution and are found to be exceedingly different in the line core. (auth)

27684 26.3 MHz RADIO SOURCE SURVEY WITH AN ABSOLUTE FLUX SCALE. Viner, M. R. College Park, MD; Univ. of Maryland (1973). 247p. University Microfilms Order No. 74-17,066.

Thesis (Ph. D.).

Absolute flux densities of the radio sources Cyg A, Cas A, Tau A and Vir A were measured at 26.3 Mhz with an accuracy of about ±5% using half-wave dipole over a ground screen and the eight-element grating array at the University of Maryland's Clark Lake Radio Observatory. A summary of accurate relative and absolute measurements on the four sources was compiled, and the spectrum of each source was discussed in detail. No evidence of time variations was found for any of the sources during the absolute measurements. A total of 446 sources were observed, of which 21 have not previously been catalogued. Upper limits were obtained for the flux densities of an additional 50 sources selected from the Third Cambridge Catalog. The average number of observations per source is 12, giving good statistical precision to the positions and flux densities of a large sample of radio sources. Angular structure information of some importance for several extended sources was obtained for the first time at low radio frequencies using the relatively narrow east-west beamwidth of the compound interferometer. A search for possible variability among the sky survey sources was carried out. If there is a class of variable radio sources at low radio frequencies, they probably constitute less than 5% of the population. (Diss. Abstr. Int., B)

27685 COMPARISON OF A GALACTIC AND A LARGE MAGELLANIC CLOUD G-TYPE SUPERGIANT. Fry, M. A. Los Angeles; University of California (1973). 143p. University Microfilms Order No. 74-11,528.

Thesis (Ph. D.).

The abundances of the metals in the atmospheres of a G-type supergiant in the Large Magellanic Cloud and one in the Galaxy were investigated. The major difficulties in determining the abundances are the complex spectra of a later-type star and the limited number of lines with reliable f-values. The proper choice of a model atmosphere was investigated. After a suitable atmosphere is chosen and after the pertinent parameters, microturbulence, macroturbulence, and damping constant are reconciled, one is able to synthesize the spectra of the G-type supergiants R59 and HR8752, types G4Ia. An attempt was made to utilize moderately strong lines with reliably determined gf values. After these lines are fitted to the observed spectra, one is able to deduce the chemical abundance of the element under study. To facilitate the study of a G-type supergiant in our galaxy, HR8752 was chosen as a comparison star. Both stars were studied, and abundances were obtained. The deduced abundances of both supergiants indicate a close similarity to the solar abundances. The individual scatter among each element is approximately 0.4 dex. A comparison of the two supergiants indicates that the star in the LMC is slightly underabundant with respect to the star in our galaxy. Since only two other stars in the LMC have been analyzed in detail, this study should be of interest. The results of the investigations into the stellar abundances in the LMC reveal small differences in the chemical abundances between the LMC and our Galaxy. (Diss. Abstr. Int., B)

27686 PHOTOELECTRIC INVESTIGATIONS OF AA CETI AND UZ PUPPIS. Bloomer, R. H. Jr. Gainesville, FL; University of Florida (1973). 189p. University Microfilms Order No. 74-9534.

Thesis (Ph. D.).

These two eclipsing binary stars were observed photoelectrically by using thirty-inch reflecting telescope. The entire light variation of each star was measured in three colors, and a total of over 1,400 useful observations were made. A period study was undertaken for each star, and solutions of the light curves were found based upon the Russell-Merrill model. The orbital period of the system AA Ceti was found to be 0.53617353d ± 0.00000050d p.e. The light curves which were constructed displayed W UMa-type variations. The total secondary eclipse was flat at yellow and blue wavelengths, but the system became significantly fainter in ultraviolet light as the total phase progressed. The resulting solutions indicated that the secondary eclipse was an occultation and that the stars were unusually different in size for this type of binary system. UZ Puppis was observed photoelectrically on thirteen nights. The period derived from these photoelectric data and some old times of minimum light gave a refined period of 0.79485183d ± 0.00000004d. The light curves were similar in shape to those of β Lyrae and indicated that the eclipses were partial. The center of the secondary eclipse was displaced from a phase of 0.5, and the star showed a significant "periastron effect." Solutions resulting from this investigation indicated that the secondary eclipse was an occultation of the smaller star and that there was a large amount of third light present in the system. Solutions both with and without the assumption of third light were found. (RWR)

27687 SPONTANEOUS FISSION ON THE Ap STARR HR465. Ohnishi, T. (Kyoto Univ.). Nature (London); 249: No. 5457, 532-533(7 Jun 1974).

It is stated that there is an anomalously high abundance of elements of the Cr-Eu subgroup on the Ap star HR 465, and the overall abundance pattern suggests that these elements originate by r-process nucleosynthesis. In the r-process abundance curve there is a broad peak in the rare earth region centered around $Z \simeq 65$: the rare earth elements on HR 465, however show a peak near Nd and Sm, at $Z = 60$ to 62, clearly differing from the trend of the r-abundance pattern. Also, the rare earth peak on HR 465 does not correspond to the s-proces abundance peak around Ba and La. It is suggested here that the rare earth anomaly on HR 465 originates from asymetric spontaneous fission of r-nuclides with 250. A 265 taking place in the later period of the r-process cooling. (UK)

27688 COPERNICUS SPECTRA OF β LYREA. Hack, M. (Osservatorio Astronomico, Trieste, Italy); Hutchings, J. B.; Kondo, Y.; McClusky, G. E.; Plavec, M.; Polidan, R. S. Nature (London); 249: No. 5457, 534-536(7 Jun 1974).

Observations are described of the far UV spectrum of β Lyrae, made using the Princeton spectrometer on the Copernicus satellite, during August and September 1973. The observed spectrum contained many emission lines, some with P Cygni type profiles, some of very high excitation, but none with radial velocities associating them with the primary B star. It seems that the spectrum was predominantly from a hotter source than the visible primary, supporting recent suggestions that the secondary component in β-Lyrae is the hotter object. The far UV spectrum appears to be unique amongst those so far observed by Copernicus as regards the number and strength of emission lines. The profiles were typical of a rotating outward moving envelope with expansion velocities of ~150 km/sec, and a rapidly rotating hot secondary with an outward moving envelope or an expanding shell around the system is suggested. The components of the spectra are described and discussed. The most important features are stated to be the NV lines, which indicate very high excitation. The velocity amplitude of the lines suggests that the secondary is the more massive object, by a factor of several times. Its spectrum is invisible in the terrestrial spectrum either because it is shielded by the extended envelope, or because the B8 star is overluminous. In an alternative representation of the system the secondary is a black hole, but a complication discussed is evolutionary history. (UK)

27689 FURTHER SIMULTANEOUS HARD X-RAY AND OPTICAL OBSERVATIONS OF Sco X-1. Matsuoka, M.; Miyamoto, S.; Nishimura, J. (Tokyo Univ.). Nature (London); 250: No. 5461, 38-40(5 Jul 1974).

Reference is first made to earlier observations of Sco X-1 (see Prog. Elementary Particle Cosmic Ray Phys. 10: 303 (1971); Nature Phys. Sci. 236: 53 (1972); Astrophys. Space Sci. 18: 472 (1972)). The results are then given of a balloon flight made in April 1972 from Hyderabad in which hard x-ray spectra were obtained for use in a study of the correlation between x-ray and optical emissions. Simultaneously with the baloon flight Sco X-1 was observed photographically with a 12 inch reflecting astrograph at Hyderabad, with an 8 inch astrograph at Nizamiah Observatory, and photoelectrically with a 48 inch reflector at Rangapur Observatory. A positive correlation was found in the optically bright phase. The observed features are interpreted in terms of thermal bremsstrahlung from a hot semi-opaque plasma. (UK)

27690 ORIGIN OF NEUTRON STAR MAGNETIC FIELDS. Levy, E. H.; Rose, W. K. (Bartol Research Foundation, Swarthmore, PA). Nature (London); 250: No. 5461, 40-41(5 Jul 1974).

It is stated that pulsars are thought to be rapidly rotating neutron stars having poloidal magnetic fields with intensities consistently in the range 10^{12} to 10^{13} gauss, and the origin of pulsar magnetic fields with nearly uniform intensities is a matter of considerable interest. If a main sequence star with dimensions of $\sim 10^{11}$ cm has a poloidal field of about 100 gauss in its interior, then it is generally argued that conserved magnetic flux during collapse to neutron star dimensions of $\sim 10^6$ cm will produce a magnetic field of the order of 10^{12} gauss. It is, however, considered that turbulent transport and mixing of the magnetic field, during the convective C-burning stage, will dominate behavior in the core, and notions of conserved magnetic flux do not apply. In this connection it was suggested that turbulent convection during the C-burning stage will produce a magnetic field with energy density equal to the kinetic energy density of the convecting fluid. Although it is felt that such a speculation is along the right lines

it contains significant difficulties; these are discussed. It is suggested that convection during the C-burning stage, before collapse to a neutron star, leads to the production of a large scale magnetic field within the core through hydromagnetic dynamo action, and that this is the progenitor of pulsar magnetic field. (UK)

27691 DO BLACK HOLES REALLY EXPLODE? Davies, P. C. W.; Taylor, J. G. (King's Coll., London). Nature (London); 250: No. 5461, 37-38(5 Jul 1974).

It is stated that during the collapse of a spherically symmetric object the production of massless particles is expected. Many of these particles will escape from the surface of the object, and the energy removed in this way will slow down the collapse and may even prevent it completely: the object will then "explode" in a burst of radiation. Exact calculations of such an explosion are not possible with present theory, but a rough idea is described for estimating the amount of particle emission as the collapse proceeds. The findings appear to be in conflict with those of Hawkins (Nature 248: 30(1974)), whose references to "explosion" seem to be more in the nature of slow "leaks." (UK)

27692 GAMMA RAYS FROM BLACK HOLES. Dahlbacka, G. H.; Chapline, G. F.; Weaver, T. A. (Univ. of California, Livermore). Nature (London); 250: No. 5461, 36-37(5 Jul 1974).

Experimental pion production cross sections are used to calculate the rate of production of γ-rays from black holes. A characteristic γ-ray spectrum is reproduced, peaking at 18 MeV regardless of the mass of the black hole or the interstellar density. Matter accreting on to a black hole may be heated to very high temperatures and radiate γ-rays. At temperatures in excess of 100 MeV proton–proton collisions result in copious pion production and γ-rays are produced due to the decay $\pi^0 \rightarrow 2\gamma$, and this process represents the main contribution to the γ-ray luminosity of black holes. An expression is given for the total rate of emission of γ-rays resulting from spherical accretion. (UK)

27693 CIRCULAR ORBITS IN THE KERR METRIC. Kurmakaev, Z.K. (Astrophysical Institute, Kazakh Academy of Sciences, Alma–Ata). Sov. Astron.–AJ 18: No. 1, 110-111 (July 1974).

The constants and sidereal periods are determined in coordinate and proper time for circular motion of a particle in the equatorial plane of a rotating body. Some quantitative estimates are obtained. (auth)

27694 RADIATION OF GRAVITATIONAL WAVES BY A CLUSTER OF SUPERDENSE STARS. Zel'dovich, Y.B.; Polnarev, A.G. (Institute of Applied Mathematics, Academy of Sciences of the USSR). Sov. Astron.–AJ 18: No. 1, 17-23 (July 1974).

An analysis is given of the mechanism whereby collapsed stars in the galactic nucleus will emit gravitational radiation when they pass each other. Estimates are obtained for the annual number of encounters such that a pulse of gravitational radiation with a given spectrum might be observable. (auth)

27695 AN APPROACH TO THE THIRD–INTEGRAL PROBLEM FOR STATIONARY STELLAR SYSTEMS. Osipkov, L.P. (Leningrad University). Sov. Astron.–AJ 18: No. 1, 54-59 (July 1974).

To investigate the third integral K(P,Z,ρ,z), the customary projections of the velocity vector (P,Z) are replaced by polar coordinates (V, α), with P=V cos α, Z=V sin α. It is determined what isolating properties the integral K has in these coordinates. Since K is a 2π–periodic function of α, it can be expanded in Fourier series. A recurrent system of partial differential equations is obtained for the coefficients in the expansion. Let A=D(H,K)/D(P,Z), where H is the energy integral; then A=δK/$\delta\alpha$. On the other hand, $|A^{-1}|$ is proportional to the density of a stream of stars with equal H and K but different initial positions. Accordingly, K can be determined from a numerical experiment by integrating the equations of stellar motion in a given field and appealing to the ergodic theorem. (auth)

27696 RADIATION OF PHOTOSPHERES WITH SCATTERING–DOMINATED OPACITY. Syunyaev, R.A.; Shakura, N.I. (Institute of Applied Mathematics, Academy of Sciences of the USSR). Sov. Astron.–AJ 18: No. 1, 60-61 (July 1974).

The Stefan–Boltzmann law does not describe the radiation flux emerging from an optically thick medium if electron scattering plays a predominant role in the opacity. Equations are obtained relating the radiant energy flux to the temperature of the radiating plasma for isothermal atmospheres with a homogeneous, exponential, or power–law density profile. (auth)

27697 VARIABILITY IN THE RU MONOCEROTIS SYSTEM. Martynov, D.Y. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 18: No. 1, 62-67 (July 1974).

New photometric elements for RU Mon are derived from photoelectric observations during 1968–1971. The orbital period of the binary has once again become shorter, and the luminosities of both components have changed since 1964–1965. An apsidal rotation period of $\simeq$285 yr has been established with confidence. Further spectroscopic observations and systematic photometry of Ru Mon are needed, especially during the 1980–1981 season, when the longitude of periastron will reach 90°. (auth)

27698 SPACE DISTRIBUTION OF FLARE STARS IN THE PLEIADES. Kholopov, P.N. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 18: No. 1, 68-70 (July 1974).

The density distribution of 230 flare variables in the Pleiades cluster brighter than $18^m.5$ pg and 81 fainter than $18^m.5$ at minimum light is examined. The subsystem of flare variables brighter than $18^m.5$ is centered 13'.5 NNW of Alcyone, at $\alpha=3^h40^m.9$, $\delta+23°59$ (1900.0). These brighter variables are definitely concentrated toward the center of the system. The variables fainter than $18^m.5$ exhibit a reduced density in the central region of the Pleiades (30' in radius), which contains the bright cluster members and the associated nebulosity. There is a selection effect for discovery of faint variables in this region. This effect probably explains the claim of Mirzoyan and Mnatsakanyan, who have considered the entire population of such objects, that flare variables are missing from the central region of the Pleiades, 1.4 pc (36') in radius. Actually the distribution of flare stars brighter than $18^m.5$ shows no pecularities: Like the brighter constant stars, they are concentrated toward the center of the system. (auth)

27699 INFRARED PHOTOMETRY OF RED GIANTS IN THE GLOBULAR CLUSTERS M13, M71, M92, AND M5. I. Rusev, R.M. (Bulgaria). Sov. Astron.–AJ 18: No. 1, 71-76 (July 1974).

Infrared photographs of the globular clusters M13, M71, M92, and M5 were taken in the summer of 1971 with the AZT–14 telescope (D=48 cm) of the Shternberg Astronomical Institute's Crimean station, equipped with a two–chamber cesium oxide electronic image converter. After investigation of the photometric error of the image–tube screen and calibration against A0 stars in the open cluster NGC 7209, I magnitudes (λ_{eff}=8460 Å, λ=2050 Å) were determined for 34 stars in M13, 19 in M71, 17 in M92, and nine in M5. The rms error in a single I determination was $\simeq\pm0.^m10$. As Eggen has shown, the B–V color of Johnson and Morgan's system is not an effective temperature criterion for red giants with B–V$\geq+1.^m5$. The (I, B–V) and (I, B–I) diagrams prepared for each cluster demonstrate that I magnitudes and B–I colors are effective luminosity and temperature indicators for red giants in globular clusters. Some globular clusters contain very red giants which are shifted toward the "early" part of the giant branch in ordinary (V,B–V) diagrams since the V magnitudes are distorted by TiO absorption bands and heavy elements, whereas the (I, B–I) diagrams show that the stars are actually located at the upper right end of the branch. Finally, a composite [M_I, $(B-I)_0$] diagram for the four clusters indicates that a special sequence of peak red giants may exist, with a smaller slope than the red–giant and asymptotic–branch sequences. Stars in the peak red giant phase are evidently close to their helium flash. (auth)

27700 NORMAL CEPHEID COLOR INDICES. IV. Nikolov, N.S.; Ivanov, G.R. (Sofia University Observatory, Varna Observatory, Bulgaria). Sov. Astron.–AJ 18: No. 1, 77-80 (July 1974).

The relation obtained in Paper III between the spectrum and intrinsic U–B color of Cepheids is revised, using extensive spectroscopic data on a uniform system. This revised [Sp, $(U-B)_0$] relation is expressed in terms of the Tonantzintla photometry. A more effective method is proposed for correcting for the phase dependence of the color excess E_{U-B} (caused by the periodic variability of spectral type). Together with Tsarevskii and Yakimova's [Sp, $(B-V)_0$] relation, the new [Sp, $(U-B)_0$] relation determines the position of Cepheids in the two–color diagram. The results are compared with those of Makarenko and Fernie, and with the findings of Papers I–III. (auth)

27701 INTERACTION BETWEEN SUPERNOVA REMNANTS AND THE INTERSTELLAR MEDIUM. Bychkov, K.V. (Special Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.–AJ 18: No. 1, 11-13 (July 1974).

Dense ($n_H\simeq10^3$ cm^{-3}), cool knots in supernova remnants, such as the "nonstationary" filaments in Cas A and the Crab Nebula filaments, can become detached from the nebula as it decelerates, and then travel independently for considerable distances through the intersteller medium. The stability of these structures is discussed, as well as the possibilities for observing them at radio, optical, and ultraviolet wavelengths. Proper motions of detached filaments could provide an estimate for the age of their parent nebula. (auth)

27702 WHAT TYPE OF SUPERNOVA IS RESPONSIBLE FOR MOST OBSERVED REMNANTS?. Shklovskii, I.S. (Institute for Space Research, Academy of Sciences of the USSR, Moscow). Sov. Astron.–AJ 18: No. 1, 1-3 (July 1974).

The mass of the supernova responsible for the filamentary nebulosity comprising the Cygnus Loop could not have exceeded 1.5–2 $M_\odot$. Most other "old" remnants should also have originated from low–mass type I supernovae. These remnants will preferentially be found in interstellar gas clouds, where their survival time should be longer. The Crab Nebula is a peculiar object because of the abnormally low ejection velocity of the envelope of the 1054 supernova. (auth)

27703 LIGHT SCATTERING IN AN INHOMOGENEOUS ATMOSPHERE. Sobolev, V.V. (Leningrad University). Sov. Astron.—AJ 18: No. 1, 30-32 (July 1974).

The problem of diffuse reflection and transmission by an isotropically scattering atmosphere is considered. The single—scattering albedo is first assumed arbitrary function of optical depth, and is then specialized to a step function. Three methods of solution are described for the particular case of a two—layer atmosphere comprising a semiinfinite medium and a layer of finite optical thickness above it. (auth)

27704 STAR ENCOUNTERS IN SPHERICAL STELLAR SYSTEMS. Danilov, V.M. (A. M. Gor'kii University of the Urals). Sov. Astron.—AJ 18: No. 1, 49-53 (July 1974).

A general equation is derived for the probability of a stellar encounter with a specified change in the speed of the star in a system whose regular—force potential depends only on the distance from the center of mass. The probability is first evaluated for binary encounters, and the effect of multiple encounters is then taken into account. An approximate stellar velocity distribution function is obtained in analytic form and used to establish the encounter probability. With this probability an integral equation is formulated for the distribution function with respect to the absolute value of the velocity at each point of the stellar system; the initial (approximated) distribution function can then be reconciled with the solution of the integral equation. (auth)

27705 ROSETTE NEBULA. Boerngen, F.; Hoegner, W.; Lochno, P.; Richter, N. (Karl-Schwarzschild Observatory, Tautenburg, Ger.). Jena Rev.; 6: 331-332(1973).

A photograph of the rosette emission nebula in the Monoceros constellation is shown and discussed. It is suggested that it is time to resume with the improved means of observation the astrophysical description and interpretation of this celestial object. (MHR)

27706 A NEW PHENOMENON IN THE SPECTRUM—OF SIGMA ORIONIS E. Walborn, N.R. (Cerro Tololo Inter—American Observatory). Astrophys. J. Lett. 191: No. 2, L95-L98 (15 July 1974).

A broad variable emission has been found at Hα in the spectrum of the helium—rich star σ Ori E. The feature is a Wolf—Rayet—like band of maximum width near 1800 km s^{-1}, which fills in the deep Hα absorption and reaches maximum intensities of nearly 30 percent above the continuum on either side. The emission intensity undergoes large variations with a time scale of a few hours. Radial—velocity measures do not establish binary motion, although a low—mass companion cannot be excluded. The nature of the energetic circumstellar activity reported, and its relationship to the helium anomaly, remain to be determined. (auth)

27707 OPTICAL POLARIZATION OF SELECTED HERBIG—HARO OBJECTS. Strom, K.M.; Strom, S.E.; Kinman, T.D. (Kitt Peak National Observatory, Tucson, Arizona 85726). Astrophys. J. Lett. 191: No. 2, L93-L94 (15 July 1974).

Polarimetric observations of several Herbig—Haro objects provide additional support for the view that these objects are patches of reflection nebulosity illuminated by heavily obscured young stars. (auth)

27708 THE LOCAL MASS DENSITY. Veeder, G.J. (Hale Observatories, California Institute of Technology, Carnegie Institution of Washington). Astrophys. J. Lett. 191: No. 2, L57-L58 (15 July 1974).

Recently revised masses for some faint double stars lead to an improved mass—luminosity relation for faint main—sequence stars. The total local mass density is increased to $\sim 0.2\ \mathfrak{M}_\odot\ pc^{-3}$. (auth)

27709 AN EXACT STUDY OF RIGIDLY AND RAPIDLY ROTATING STARS IN GENERAL RELATIVITY WITH APPLICATION TO THE CRAB PULSAR. Bonazzola, S.; Schneider, J. (Groupe d'Astrophysique Relativiste, Observatoire de Meudon, 92190 Meudon (France)). Astrophys. J. 191: No. 1, 273-286 (1 July 1974).

A previous method of numerical integration of the Einstein equations is applied to the problem of equilibrium configurations of relativistic rigidly rotating stars. The treatment is made with no approximations. Two cases are considered: the relativistic noninteracting Fermi gas and the incompressible fluid. The case of the Fermi gas is applied to neutron stars. Baryonic number, gravitational mass, and binding energy of a neutron star are given as functions of central density and angular velocity. The usual expression ($E_L = (1/2)I^*\Omega^2$), where E_L is the energy stored by rotation, Ω the angular velocity, and I^* the inertial momentum, is shown to hold a good approximation. A formula involving I^* and the baryonic number is also given. The inner isobaric surfaces are found to be prolate. As a consequence, and if the core of a star is in a solid state, negative glitches may occur. The incompressible—fluid case is studied in both Newtonian and relativistic conditions. A check of our method is furnished by a comparison of the classical analytical calculation and the Newtonian limit. In medium—relativistic conditions, we find the same correction to angular velocity as in the post—Newtonian approximation, but in more relativistic conditions our correction becomes larger. For larger central pressures (relativistic conditions), the post—Newtonian result for the redshift at pole of the star is found anew. In intermediate cases, the same corrections to angular velocity as in the post—Newtonian approximation are also found, although for larger central pressure these corrections are slightly larger. (auth)

27710 SPECTRAL TYPES OF M DWARF STARS. Joy, A.H. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology, Pasadena); Abt, H.A. Astrophys. J. Suppl. Ser. 28: No. 252, 1-18 (June 1974).

Spectral types on a uniform system based on primarily TiO band strengths are given for 426 M dwarf stars. It is found that the frequency of emission—line stars increases steadily from ~5 percent among the early M's through ~50 percent at M4.5 to 100 percent for M5.5 and later. The absolute magnitude of emission—line (dMe) and normal (dM) dwarfs average the same within 0.07 mag at a given spectral type. A new calibration of absolute magnitudes, based on trigonometric parallaxes, is given. The measured width of the main—sequence band can be accounted for mostly in terms of the errors in classification, parallaxes, and photometry and to some duplicity; the cosmic dispersion is less than 0.3 mag. The R—I colors of dMe stars are larger by 0.08 ± 0.02(p.e.) mag that for dM stars, although the B—V colors do not show this effect. (auth)

27711 ENERGY LIMITS ON THE PENROSE PROCESS. Wald, R.M. (Department of Physics and Astronomy, University of Maryland, College Park). Astrophys. J. 191: No. 1, 231-233 (1 July 1974).

If a body in the vicinity of a rotating black hole breaks apart into two or more fragments, then under appropriate conditions the rotational energy of the black hole can be used to enhance the energy of one of the fragments (Penrose process). Wheeler and others have suggested that the Penrose process could serve as an energy mechanism for jets. In this paper we derive strict limits on the energies which can be achieved by the Penrose process. It is shown that in no case can one obtain energies which are greater by a significant factor than those which already could be obtained by a similar breakup process without the presence of a black hole. (auth)

27712 THE STOKES PARAMETERS FOR LIGHT ARISING FROM INDUCED PROCESSES. Pomraning, G.C. (Science Applications, Inc., La Jolla, California). Astrophys. J. 191: No. 1, 183-189 (1 July 1974).

In this paper we consider the specification of the Stokes parameters associated with light arising from induced processes. These induced events occur because photons obey Bose—Einstein statistics, and their presence constitutes an additional source term in the equation of transfer for polarized light. It is found that the number of induced events can be simply expressed in terms of the Stokes parameters of the spontaneous source and the inducing field. The Stokes parameters of this induced radiation, however, depend upon additional time averages involving the variations of the spontaneous source amplitudes and phases. The case of light with certain of its properties Gaussian distributed is considered in detail. (auth)

27713 THEORETICAL EVOLUTION OF EXTREMELY METAL—POOR STARS. Wagner, R.L. (University of Texas, Austin and University of Washington, Seattle). Astrophys. J. 191: No. 1, 173-182 (1 July 1974).

Theoretical evolutionary sequences for stars in the mass range 0.65 to 2.5 $M_\odot$ having the extremely metal—deficient compositions (X,Z) = (0.739, 10^{-4}), (0.739, 10^{-5}), (0.739, 10^{-6}), (0.9999, 10^{-5}) have been calculated using a modified version of the Paczyński stellar—evolution code. The models have been evolved from the zero—age main sequence through the central density maximum accompanying core helium ignition. Selected models in each evolutionary sequence have been analyzed for secular and pulsational instability. The characteristics of extremely metal—poor stellar models were found to be somewhat sensitive to the heavy—element abundance even below $Z \simeq 10^{-4}$, and low—mass stellar lifetimes from the main sequence to central helium ignition were found to be significantly shorter than values commonly assumed for galactic evolution studies. The main—sequence models of lowest mass are pulsationally unstable with fundamental periods of about 0.67 hour. These models become pulsationally stable before central hydrogen exhaustion. The most massive stellar models for each composition become pulsationally unstable at core helium ignition, with the pulsation periods for the fundamental mode lying in the range 0.3—4.0 days. Evolutionary tracks and time—constant loci are presented for each composition. (auth)

27714 MAGNETIC FIELDS AND DIFFUSION PROCESSES IN PECULIAR A STARS. Shore, S.N. (Department of Earth and Space Sciences, State University of New York, Stony Brook, New York); Adelman, S.J. Astrophys. J. 191: No. 1, 165-172 (1 July 1974).

The detailed effects of a magnetic field on the equilibrium surface abundances of Ap stars as well as on the diffusion velocity are considered. The equivalent widths of the magnetic null lines are shown to be functions of the magnetic field strength. Furthermore, null lines can be used to help distinguish between inhomogeneities in abundance and in magnetic field strength and to determine ionization temperatures.

The results of the diffusion mechanism with magnetic fields are used to interpret the phenomenon of spectrum variability. A review of the observational aspects of null lines in the magnetic Ap stars is presented. (auth)

27715 CALCULATION OF THEORETICAL ROTATIONAL LINE PROFILES FOR THE DETERMINATION OF v SIN i IN THE SPECTRAL RANGE O9–F8. Collins II, G.W. (Perkins Observatory, The Ohio State and Ohio Wesleyan Universities). Astrophys. J. 191: No. 1, 157-164 (1 July 1974).

In this paper we present some of the results of an extensive set of model calculations for rotating main–sequence stars in the spectral range O9–F8. Line profiles have been calculated for the lines of He I λ4471, Mg II λ4481, and Fe I λ4476. It is shown that the helium and iron lines are extremely sensitive to the amount of stellar rotation while the magnesium line is not. This results in some ambiguity in spectral classification for stars in the range B7–B9. However, as a result of a corresponding rotational color effect the ambiguity would be very difficult to detect in individual stars. (auth)

27716 FE I FLUORESCENCE IN T TAURI STARS. Willson, L.A. (Department of Astronomy, University of Michigan, Ann Arbor). Astrophys. J. 191: No. 1, 143-155 (1 July 1974).

A statistical equilibrium analysis for the selective excitation of λλ4063, 4132 of Fe I shows: (a) selective excitation by Ca II or Hε can reproduce the line intensities observed in T Tauri stars; (b) when enhanced λλ4063, 4132 emission is observed, an upper limit on the electron density and/or hydrogen density as a function of distance from the star is obtained; (c) it is sometimes also possible to obtain an upper limit on the local gas kinetic temperature and a lower limit on the hydrogen density divided by the dilution factor W. Upper limits obtained for RW Aurigae are: $N_e/W \leq 10^{16}$ and $N_H/W \leq 10^{16}$ if H II/H I ≤ 0.1, for $T_e = 3000°K$. Also, $N_H/W > 10^{14}$ if the lines are formed less than 1000 stellar radii from the star. A qualitative model is suggested for RW Aurigae where the Fe I lines are formed in an expanding envelope, beyond 10 stellar radii from the central star. Although Ca II H is a stronger emission line than Hε in some T Tauri stars, considerations of the velocity shifts expected for different parts of the envelope indicate that Hε may be responsible for the selective excitation of λλ4063, 4132. (auth)

27717 INFRARED AND OPTICAL OBSERVATIONS OF HERBIG–HARO OBJECTS. Strom, S.E.; Grasdalen, G.L.; Strom, K.M. (Kitt Peak National Observatory, Tucson, Arizona 85726). Astrophys. J. 191: No. 1, 111-142 (1 July 1974).

Evidence is presented to support the view that Herbig–Haro (H–H) objects represent reflection nebulae illuminated by optically invisible stars (H–H stars) which are probably no older than a few hundred thousand years. The H–H stars are thought to represent the predecessors of those field T Tauri stars which possess circumstellar nebulae having emission–line characteristics very similar to those of the H–H objects. Several of these H–H stars have been discovered by means of infrared surveys of the dark cloud regions containing H–H objects. In general, they are displaced relative to the optical H–H objects and seem to be deeply embedded in dark cloud material; the H–H stars studied here are probably obscured by between 10 and 30 magnitudes of visual extinction. Several H–H objects have large angular dimensions, reminiscent of variable reflection nebulae such as NGC 6726 and Hubble's variable nebulae NGC 2261. Moreover, these objects are shown to have the relatively large, radial linear polarization characteristic of more ordinary reflection nebulae. The chance illumination of a reflection nebula by a young stellar evolution provides a fortunate opportunity to study some characteristics of the early phases of stellar evolution which otherwise would be hidden from view. The study of the emission–line radial velocities suggests for the H–H stars a mass outflow similar to that observed in most young emission–line objects. If this interpretation is correct, then mass outflow rather than infall characterizes young stars, even at ages of a few hundred thousand years or less. Finally, if the H–H stars are viewed as the direct predecessors of T Tauri stars or other young emission–line objects, it is possible to make some tentative statements about the evolutionary history of dark interstellar clouds. (auth)

27718 SCATTERING IN THE SHELL OF ETA CARINAE. Craine, E.R. (Perkins Observatory, The Ohio State and Ohio Wesleyan Universities). Astrophys. J. 191: No. 1, 105-109 (1 July 1974).

A discussion of characteristic differences between the core and shell spectra of η Car is presented. Previous polarization observations strongly suggest the possibility that scattering mechanisms are active in the production of the shell spectra. A simple model is analyzed for the effects of scattering in the shell and it appears that scattering by grains as well as the hypothesized scattering by electrons may be present. The scattering model supports the suggestion that a B1–type star may be one component of the core of η Car. (auth)

27719 CORE–HELIUM–BURNING STARS IN YOUNG CLUSTERS IN THE LARGE MAGELLANIC CLOUD. Robertson, J.W. (Mount Stromlo and Siding Spring Observatories, Research School of Physical Sciences, The Australian National University). Astrophys. J. 191: No. 1, 67-78 (1 July 1974).

Photometry of seven Large Magellanic Cloud clusters, presented elsewhere by Robertson, is compared with theoretical core–helium–burning evolutionary sequences. Six of the clusters have ages $t \simeq 3 \times 10^7$ years; and the seventh cluster, NGC 1866, has $t \simeq 7 \times 10^7$ years. The observed color–magnitude diagrams demonstrate the increase in the length of the "Cepheid loop," with increasing stellar mass, as predicted by the theoretical sequences. The observed spread in luminosity of the blue giants suggests that star formation occurred over a period of $\Delta t \lesssim 10^7$ years (although Δt may be as small as a few million years). The observed ratio of the number of giants to the number of main–sequence stars agrees with the theoretical ratio of core–helium–burning to core–hydrogen–burning lifetime. There is some observational evidence that the ratio t_w of the number of blue giants to the number of red giants is a measure of the chemical composition, and the observed values of t_w tentatively indicate low Z or high Y for the peculiar cluster NGC 2136 and possibly high Z or low Y for the outlying cluster NGC 2214. Several stars above the main sequence in the younger clusters may be binaries which have undergone mass exchange. The observational evidence for increases in the envelope opacities, presented earlier by Robertson, is reviewed and found to be inconclusive because of the new data for NGC 1866. (auth)

27720 FREE PRECESSION OF NEUTRON STARS. Pines, D.; Shaham, J. (Univ. of Illinois, Urbana). Nature (London); 248: No. 5448, 483-486(5 Apr 1974).

27721 LARGE FLARE ON THE RED DWARF STAR UV CETI. Lovell, B.; Mavridis, L. N.; Contadakis, M. W. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Nature (London); 250: No. 5462, 124-125(12 Jul 1974).

Simultaneous radio and optical recordings are described, obtained on 11th October 1972, of an unusually large flare on UV Ceti, during which the apparent magnitude increased by more than 4.55 mag. The observations were made simultaneously with the Mk.1A radiotelescope at Jodrell Bank and the 30 inch Cassegrain reflector at the Stephanion Astronomical Station in Peloponnese. A dual channel photoelectric photometer was used with the reflector, and the telescope was working at 408 MHz. The rates of energy production during the flare were approximately 3.2×10^{25} ergs/sec over a bandwidth of 400 MHz in the radio spectrum, and 2.5×10^{30} ergs/sec over a bandwidth of 6.7×10^8 MHz in the optical spectrum. Evidence was obtained that the sharp front of the optical flare preceded that of the radio flare by approximately 8 min. (UK)

27722 MODEL FOR A FLARE ON THE STAR UV CETI. Kahn, F. D. (Univ. of Manchester, Eng.). Nature (London); 250: No. 5462, 125-127(12 Jul 1974).

Reference is made to the large flare observed on UV Ceti on 11 October 1972 at photoelectric frequencies and at the radio frequency of 408 MHz. These observations provided enough information to formulate a reasonably good model of the outer layers of the star and the overall mechanics of the flare. It is concluded that the radio flare must have occurred in a region of low gas density, otherwise the radiation could not have propagated away, and it was noted that there was a delay of about 500 sec between the onset of the flare at optical and radio frequencies; during this interval the disturbance from the optical flare must have spread through the corona of the star, and it appears that the star has a corona and a stellar wind. The energy required to heat the corona and to drive the wind must presumably come from the mechanical energy of the convective motions in and near the photosphere layers. Data are given for the mass, radius, surface gravity, surface temperature, surface area, luminosity, and radiation flux of the star. Opacity data are used to construct a rough model for the atmosphere of the star. An estimate of 900 gauss is obtained for the likely magnetic field strength at the surface of the star, and the photoelectric magnitude increased by more than 4.5 during the flare. Information deduced from events following the visual flare is discussed. The model discussed requires that a large fraction of the energy brought by convection to the photosphere shall later become available as mechanical energy for heating the stellar corona. (UK)

27723 ULTRAVIOLET SPECTRA OF CAPELLA. Gurzadyan, G. A. (Garny Space Astronomy Lab., Erevan). Nature (London); 250: No. 5463, 204-205(19 Jul 1974).

Some observations are described made from the space observatory Orion 2 on Soyuz 13. Spectrograms of Capella were recorded in the wavelength region 2,000 to 3,000 Å, using a wide angle meniscus telescope of the Cassegrain system. The continuous spectrum extended to about 2,100 Å. Over the interval 2,850 to 2,150 Å about 10 absorption "lines" could be distinguished with certainty; in actual fact each of these "lines" was a band resulting from the blending of contiguous absorption lines. A further 10 absorption lines were found with less certainty. At wavelengths of 2,800 to 2,150 Å the absorption lines pertained to neutral metals and their ions having ionization potentials 8 eV, including FeII, NiII, CuII, MgII, TiII, SnII, SiII, MoII, MnII, etc. (UK)

27724 COUPLING OF NON-LTE RADIATIVE TRANSFER WITH NON-LINEAR HYDRODYNAMICS: A STUDY IN NON-STEADY STELLAR ATMOSPHERES. Klein, R. I. Waltham, MA; Brandeis Univ. (1974). 305p. University Microfilms Order No. 74-16,822.
Thesis (Ph. D.).

The non-equilibrium processes associated with radiating shock waves in a stellar atmosphere with hydrogen composition were investigated. The mechanism for shock formation is a constant velocity piston moving into a model atmosphere constructed in radiative, hydrostatic and statistical equilibrium. The fully coupled non-linear hydrodynamics and the non-L.T.E., non-grey radiative transfer in the Lyman continuum have been solved self-consistently. The hydrodynamics was solved using a Lagrangian finite difference scheme with artificial viscosity. The time-dependent momentum equation, the fluid displacement, and the specific volume were solved for explicitly. We then solved simultaneously: (1) the non-grey radiative transfer equations; (2) the time-dependent rate equation (in which the time rate of change of the atomic occupation numbers as well as the compression of the moving atmosphere are accounted for); (3) the time-dependent energy equation; and (4) equations of charge and particle conservation. These coupled equations were solved by a complete linearization scheme (multi-dimensional Newton–Raphson) akin to that developed by Auer and Mihalas (1969). The results of these calculations indicate the development of a shock wave whose features are characterized by a narrow spike in the temperature and whose structure is determined by collisional ionization and radiative recombination processes occurring in the post-shock region. The interpretation of the shock structure was made by a steady flow analysis. The non-equilibrium process with the longest time scale determines the shock structure. When the shock is deep in the medium, its structure is collisionally dominated. At late stages in the propagation of the shock, its structure switched over from being collisionally determined, to being determined by radiative recombination processes. Radiation from the shock front played an important role in maintaining the post-shock ionization. As the shock moved into optically thinner regions of the atmosphere increasing in strength, the radiation field in the shock exceeded critical conditions necessary for the existence of an ionization front. These conditions were determined by the number of neutral atoms entering the front and the temperature of the pre-front gas. When the critical velocity for the ionization front exceeded the shock velocity, a photo-ionization front rapidly propagated out ahead of the shock front ionizing the entire pre-shock stellar atmosphere. The ionization front appeared as a luminosity flash at the surface of the star with a rise time of less than 25 seconds, and a decay time of several hundred seconds. The radiation field in all frequencies was increased by two orders of magnitude. The phenomena associated with the radiating shock tended to destroy L.T.E. and radiative equilibrium in regions where they are valid for static atmospheres. Due to the long relaxation times comparable to dynamical time scales, radiative equilibrium was sufficiently violated to warrant a closer look at models for continuous spectra of variable stars which base their interpretations on L.T.E. and represent the atmosphere by a series of quasi-static radiative equilibrium states. (Diss. Abstr. Int., B)

27725 AVERAGE RADIO SPECTRA OF PULSARS. Comella, J. M. Ithaca, NY; Cornell Univ. (1972). 210p. University Microfilms Order No. 74-18,088.
Thesis (Ph. D.).

Thirteen pulsars were observed with the telescope of the Arecibo Observatory in order to determine the average spectra of their radio emission. The sources observed were NP 0527, NP 0532, AP 0823, CP 0834, PP 0943, CP 0950, CP 1133, AP 1237, AP 1514, CP 1919, PSR 1929, JP 1933 and AP 2015. The pulsars were observed continuously for a period of one to three hours on each of about six days spaced over a period of weeks to months. The sources were, in general, observed on six different frequencies between 53 and 606 MHz. Whenever possible, observations were made simultaneously on several frequencies. The pulsar observations were calibrated by comparison with a number of continuous radio sources. In the reductions, estimates were made of the uncertainties due to receiver nonlinearity, variations of antenna gain due to zenith angle and temperature effects, finite signal-to-noise ratio and several kinds of sampling errors. The final daily average flux densities, representing the equivalent flux density which would result if the emission were not pulsed, are tabulated. An attempt was made to include estimates of the uncertainties due to the effects of both scintillations and intrinsic variations. All these effects were considered in determining the final average flux densities for each frequency and source. Straight power law spectra and/or power law spectra with low frequency cutoffs due to thermal absorption outside the source and synchrotron self absorption were least-squares fitted to the final average flux densities and error envelopes were calculated. Two basic coherence mechanisms, bunching and masering, are discussed and compared with the results. Several quantitative theories found in the literature are also mentioned. High frequency cutoffs are mentioned briefly since they are not directly observed in the data presented in this work. Four different absorption mechanisms are discussed to explain the low frequency cutoffs: absorption by thermal electrons in the interstellar medium, synchrotron self absorption, synchrotron absorption outside the emission region and cyclotron turnover. The data are not sufficiently detailed or precise to distinguish either the amplification or absorption mechanism but a number of the listed possibilities appear plausible. Finally, several correlations of integrated flux and spectral index with other pulsar parameters were attempted. If the very unusual pulsars NP 0532 and PSR 0833-45 (from the literature) are neglected, then these diagrams do not show strong correlations. The correlation between absolute integrated flux and assumed distance suggests that there may be an error in the distance scale. (Diss. Abstr. Int., B)

27726 NEW ANALYSIS OF THE $A^2\Delta - X^2\Pi$ SYSTEM OF CH AND THE CARBON TWELVE/CARBON THIRTEEN RATIO IN ARCTURUS. Krupp, B. M. College Park, MD; Univ. of Maryland (1973). 88p. University Microfilms Order No. 74-17,050.
Thesis (Ph. D.).

A more precise formula of the Hill and Van Vleck type was developed for the rotational energy levels of the components of doublet states in diatomic molecules, for intermediate coupling between Hund's case (a) and case (b). A rotational constant, H_v, which is not normally used, was accurately included in the perturbation theory development. The new formula was used to obtain new values of the molecular constants of the $A^2\Delta - X^2\Pi$ system of ^{12}CH, using the smoothed data of Gerö (1941) and of Kiess and Broida (1956). The spin-coupling constants Y_v of both electronic states are found to vary with the rotational quantum number. The revised constants have been used to predict ^{12}CH wave numbers which fit the laboratory wave numbers to high precision. Molecular constants for the $A^2\Delta - X^2\Pi$ system of ^{13}CH were derived from the ^{12}CH constants by means of the normal isotopic relations. These constants were used to generate theoretical wave lengths for the (0,0), (1,1), (2,2), (0,1) and (1,2) bands of ^{13}Ch. The predicted wavelengths agree well with the few lines of the (0,0) band of ^{13}CH observed by Richter and Tonner (1967). The fundamental bands of the $A^2\Delta - X^2\Pi$ systems of ^{12}CH and ^{13}CH were used with techniques for generating synthetic spectra and CNO abundances from Upson (1973) in order to determine the $^{12}C/^{13}C$ ratio in the atmosphere of Arcturus. The ratio was determined to be $^{12}C/^{13}C = 7.3 \pm 1$. (Diss. Abstr. Int., B)

27727 ODD-PARITY STABILITY OF A REISSNER–NORDSTROEM BLACK HOLE. Moncrief, V. (Univ. of California, Berkeley). Phys. Rev., D; 9: No. 10, 2707-2709(15 May 1974).

The odd-parity perturbations of a Reissner–Nordström black hole are studied through the use of a variational principle for the perturbation equations. The Hamiltonian for the perturbations is expressed in terms of a natural set of canonical variables and shown to be (weakly) positive-definite. This result is used to prove the nonexistence of unstable normal-mode solutions of the perturbation equations. The two wave equations governing gravitational and electromagnetic perturbations are decoupled by a simple transformation. (auth)

27728 EFFECTIVE TEMPERATURES, SURFACE GRAVITIES, AND CHEMICAL COMPOSITIONS OF EARLY B-TYPE STARS. Peters, G. J. Los Angeles; Univ. of California (1974). 338p. University Microfilms Order No. 74-18,801.
Thesis (Ph. D.).

Effective temperatures, surface gravities, and chemical compositions were determined for ten early B-type stars ranging in spectral type from B0–B3 and luminosity class II–V with the aid of the Princeton ultraviolet-line blanketed model atmospheres and the recent "unified" theory of hydrogen line broadening of Vidal, Cooper, and Smith. The stars which were analyzed were: ϕ^1 Ori, Hr 1886, HR 1887, HR 8243, ξ^1 CMa, 15 CMa, γ Peg, 22 Ori, 114 Tau, and l Her. It is concluded that the Princeton ultraviolet-line blanketed, LTE model atmospheres, in general, adequately represent the atmospheres of early B-type stars near the main sequence. The temperature scale obtained from this investigation agrees well with the one obtained by the Narrabri group from the measurement of stellar angular diameters. Masses deduced from the values of T_{eff} and log g for the stars in OB associations are consistent with stellar evolution computations. The mean chemical composition of the ten program stars is within 0.2 dex of the solar composition. However, the ratios of N/C and N/O are higher than the sun's. A curious trend of increasing microturbulence with increasing temperature and decreasing surface gravity is observed. Such a trend is in accordance with recent claims that the microturbulent parameter is a non-LTE parameter as opposed to a true velocity. (Diss. Abstr. Int., B)

27729 NON-LINEAR PULSATIONS AND EFFECTS OF THERMAL IMBALANCE. Sastri, V. K. Lincoln, NE; Univ. of Nebraska (1973). 111p. University Microfilms Order No. 74-13,018.

Thesis (Ph. D.).

Non-linear pulsations in stars are studied by a method in which the radial displacement is expanded in a Fourier series, with the coefficients depending upon the spatial coordinate. The nature and behavior of the second order terms in a variety of polytropes are investigated by this method. The linear pulsation equations with appropriate boundary conditions are solved to determine the eigenvalues and eigenfunctions. These are then utilized to determine the second order terms $-u_2(pul)$, which is a measure of the displacement of the center of pulsation for an individual particle by the second order terms and $w_2(pul)$, which is the second order anharmonic pulsational amplitude. For the polytrope n = 3.0, it is found that $w_2(pul)$ behaves very differently from $u_2(pul)$ in that the surface values of $w_2(pul)$ grow very large in some specific cases while $u_2(pul)$ remains normal and behaves in a smooth fashion. The steep increase in the values of $w_2(pul)$ is determined to be caused by resonances between the fundamental and a higher normal mode. A semi-quantitative definition of the half-width of the resonances is obtained and some implications of this on the observations are discussed. An empirical formula is found between the frequencies of the normal modes and a justification for the existence of this formula is presented. Also a procedure by which the second order terms can be determined from the eigenfunctions of the linear pulsation equations is outlined. After a brief outline of the observational and theoretical aspects of a nova mechanism, the condition for vibrational stability of a star is derived and applied to two evolving nova models in an attempt to determine the pulsational stability of shell-burning stars in thermal imbalance. It is found that both the pre-nova models studied are unstable in a number of modes besides the fundamental. Further, it is demonstrated for the first time to the author's knowledge, that a mode can be stabilized because of thermal imbalance terms. Though this model cannot be offered as an example of a star undergoing an outburst through the pulsation mechanism, the existence of multi-modal radial instability in a variety of stars with burning shells in thermal imbalance is established. Some inadequacies in the present calculations have been pointed out and brief comments on the validity of the present approach have been made. Finally, the consequences of multi-modal instability and a possible connection with the multiple periodicities of a variety of very faint rapid blue variable stars detected in the recent years are discussed. (Diss. Abstr. Int., B)

27730 BLACK-HOLE PHYSICS. Some Effects of Gravity on the Radiation Emission. Feliche, F. de; Calvani, M. (Padua Univ. (Italy). Instituto di Astronomia); Nobili, L. (Padua Univ. (Italy). Instituto di Fisica). Astron. Astrophys.; 30: No. 1, 111-118(Jan 1974).

7 figs.; 25 refs.

The effects of the gravitational dragging on the electromagnetic radiation emitted by particles which move on right bound orbits around a Kerr black hole are found to change the photon frequency shift $1 + z$ from values smaller than 1 to values much larger than 1 with a periodicity of about 10^{-4} (M/M solar). The energy of the emitted radiation, as measured by a distant observer, turns out to be confined in pulses with the same periodicity. (GE)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 27652.

27731 THE V1057 CYGNI OH SOURCE: TIME VARIATION, POLARIZATION PROPERTIES, AND ACCURATE POSITION. Lo, K.Y.; Bechis, K.P. (Department of Physics, Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts). Astrophys. J. Lett. 190: No. 3, L125-L128 (15 June 1974).

The position of the 1720-MHz OH source associated with the peculiar star V1057 Cygni was determined to be α (1950) $=20^h57^m06^s.3 \pm 0^s.2$δ (1950) $=44°03'45''.7 \pm 1''$, in an agreement with the star position. Polarization studies indicate that the line profile is consistent with one right- and one left-circularly polarized component, and an unpolarized component at an intermediate frequency, suggesting a Zeeman pattern that has undergone Faraday depolarization. This is consistent with a magnetic field of ~1.5 milligauss. The intensity of the OH source has decreased by a factor of 5 in five months. (auth)

27732 3C 66A: A BRIGHT NEW QUASI-STELLAR OBJECT. Wills, B.J.; Wills, D. (McDonald Observatory and Department of Astronomy, University of Texas at Austin). Astrophys. J. Lett. 190: No. 3, L97-L98 (15 June 1974).

The strong unresolved radio source 3C 66A, lying 6'.5 from 3C 66B (identified with a 13-mag galaxy), has been identified as a 15.2-mag blue stellar object having QSO colors and a continuous optical spectrum. (auth)

27733 MOLECULAR-HYDROGEN ABSORPTION FEATURES IN THE SPECTRUM OF QUASI-STELLAR OBJECT 4C 05.34. Carlson, R.W. (Department of Physics, University of Southern California, Los Angeles, California 90007). Astrophys. J. Lett. 190: No. 3, L99-L100 (15 June 1974).

It is suggested that short-wavelength absorption features in the spectrum of 4C 05.34 correspond to the R(0) lines of the Lyman and Werner band systems of H_2. The derived redshift of these features is z=2.6354. (auth)

27734 OPTICAL OBSERVATIONS OF THE RADIO SOURCE 0735+178. Carswell, R.F.; Strittmatter, P.A.; Williams, R.E. (Steward Observatory, University of Arizona); Kinman, T.D.; Serkowski, K. Astrophys. J. Lett. 190: No. 3, L101-L104 (15 June 1974).

It is shown that the variable radio source 0735+178, which has no optical emission lines in its spectrum, varies substantially in both optical flux ($\Delta m_B \sim 1$ mag) and polarization (5-30 percent) on time scales less than a month. It is therefore assigned to the class of objects containing BL Lac and OJ 287. The spectrum of 0735+178 does, however, contain two sharp absorption features at 3981 and 3991 Å which are identified with the Mg II λ2798 doublet at a redshift z = 0.424. This confirms that 0735+178 is extragalactic with similar implications for other members of the class. The presence of highly redshifted absorption lines in 0735+178 also strengths the hypothesis that these objects are similar to quasars. (auth)

27735 THE DOUBLE QUASAR 1548+115a,b As A GRAVITATIONAL LENS. Gott, J.R. III (California Institute of Technology); Gunn, J.E. Astrophys. J. Lett. 190: No. 3, L105-L108 (15 June 1974).

The two quasars 1548+115a (17th mag; z=0.4359) and 1548+115b (19th mag; z=1.901) are separated by only 5" of arc. We consider the possibility that the light from the distant quasar is enhanced by the gravitational-lens effect of the nearby quasar and any galaxy in which it may reside. The observed separation allows one immediatley to set a strict upper limit of $7 \times 10^{12} \mathfrak{M}_\odot$ on the mass of the system containing 1548a. If $\mathfrak{M}$ is between about 4 and $7 \times 10^{12} \mathfrak{M}_\odot$, gravitational-lens brightening of 1548b roughly doubles our probability of finding such a close pair. It is perhaps significant that this mass range is just that observed for giant elliptical galaxies (radio galaxies). It is likely that the lens forms a fainter but still observable secondary image of 1548b on the other side of 1548a. Identification of such a secondary image would verify the lens effect and indicate that the two quasars are seen in projection rather than being physically connected. (auth)

27736 A NEW MEASUREMENT OF THE HERCULES X-1 X-RAY PULSE PROFILE. Holt, S.S.; Boldt, E.A.; Rothschild, R.E.; Saba, J.L.R.; Serlemitsos, P.J. (Laboratory for High Energy Astrophysics, NASA/Goddard Space Flight Center, Greenbelt, Maryland 20771). Astrophys. J. Lett. 190: No. 3, L109-L111 (15 June 1974).

We have measured a triple-peaked 1.24-s pulse profile in a 1-minute rocket-borne exposure to Her X-1, in contrast to the double-peaked profiles expected from models which maximize the X-ray emission at the magnetic equator of an accreting neutron star. The profile exhibits statistically significant energy dependence, with the emission ~12 keV having narrower peaks which appear to lag (by approximately 5% of the pulse period) the corresponding peaks at lower energies. Approximately one-third of the total emission from the source is nonpulsed. (auth)

27737 LIMITS ON RAPID X-RAY PULSING IN X-RAY BINARIES. Spada, G.; Bradt, H.; Doxsey, R.; Levine, A.; Rappaport, S. (Physics Department and Center for Space Research, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Astrophys. J. Lett. 190: No. 3, L113-L115 (15 June 1974).

The X-ray variability of Cir X-1 (3U 1516-56) and Vela X-1 (3U 0900-40) has been investigated down to 1 ms time resolution in a recent sounding rocket experiment. Sporadic flaring activity on time scales from 1 to several seconds was observed, corresponding to intensity changes of about 20 percent in Cir X-1 and up to 100 percent in Vela X-1. No periodic, aperiodic, or quasi-periodic pulsations were found with time constants less than 1 s. This and our earlier work place upper limits for rapid periodic pulsing on five of the eight known X-ray binary sources (Cir X-1, Cyg X-1, Vela X-1, Her X-1, and 3U 1700-37). If we exclude the well-known 1.24-s period of Her X-1, the limits range from 3 to 15 percent (3 σ) of the source intensity for periods down to 2 ms. (auth)

27738 INTERSTELLAR SCATTERING OF THE VELA PULSAR. Backer, D.C. (Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. 190: No. 3, 667-671 (15 June 1974).

The frequency dependence of the parameters of interstellar scattering between 837 and 8085 MHz for the Vela pulsar are consistent with thin-screen models of strong scattering. The magnitudes of the parameters indicate an anomalous turbulence along the path when they are compared with results for other pulsars with comparable column densities of free electrons in the line of sight. This anomaly is due presumably to the Gum Nebula. The decorrelation frequency, appropriately defined, is related to the pulse broadening time by 2π as predicted theoretically. (auth)

27739 INDEX OF REFRACTION OF PLASMA IN MOTION. Elitzur, M. (California Institute of Technology, Pasadena, California). Astrophys. J. 190: No. 3, 673-674 (15 June 1974).

Index of refraction is calculated for plasma which streams in a specified direction with relativistic velocities. When applied to emission from pulsars, the model indicates that the low-frequency cutoff observed in the spectrum of some slowly rotating pulsars cannot be due to plasma effects. It is suggested that it is the result of self-absorption by the emitting bunches. (auth)

27740 SPECTROSCOPIC OBSERVATIONS OF OBJECTS IDENTIFIED WITH RADIO SOURCES. Strittmatter, P.A.; Carswell, R.F.; Gilbert, G. (Steward Observatory, University of Arizona); Burbidge, E.M. Astrophys. J. 190: No. 3, 509-514 (15 June 1974).

Results of a spectroscopic survey of radio identifications are reported. Redshifts have been determined for 20 quasars and seven radio galaxies. A large proportion of identifications with neutral-colored stellar objects appear to have continuous spectra of the BL Lacertae type. Thus while very high-redshift QSOs will turn up in such a sample, their frequency is probably fairly rare. (auth)

27741 THE EXTENDED X-RAY SOURCE IN VIRGO AND ITS RELATION TO M87. Catura, R.C.; Acton, L.W.; Johnson, H.M.; Zaumen, W.T. (Lockheed Palo Alto Research Laboratory, 3251 Hanover Street, Palo Alto, California 94304). Astrophys. J. 190: No. 3, 521-523 (15 June 1974).

Spectral data in the 0.2-1.6 keV range are presented for the extended X-ray source in the Virgo cluster. When combined with Uhuru data, the simplest function which fits the composite spectrum from 0.2 to 10 keV is one describing bremsstrahlung from an isothermal plasma at 36×10^6 °K. Production of the X-rays by inverse Compton scattering is also considered and models relating the X-ray source to M87 are discussed. (auth)

27742 NATURE OF EXTENDED EXTRAGALACTIC X-RAY SOURCES. Shklovskii, I.S. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 6, 828-829 (May 1974).

An analysis of the x rays and radio emission of the extended sources in the Virgo and Perseus galaxy clusters shows that the inverse Compton effect could not be responsible for the x rays. They probably emanate from hot plasma, whose mass is estimated. In the extended Virgo source the hot plasma might be associated with the evolution of stars in NGC 4486. (auth)

27743 PUMPING MECHANISMS FOR MASER H_2O SOURCES. Strel'nitskii, V.S. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 6, 717-724 (May 1974).

Solution techniques and results are described for the problems of radiative (near infrared and ultraviolet) as well as chemical and collisional pumping of cosmic maser sources in the 1.35-cm H_2O line. To deal with radiative pumping of the multilevel system, a method is proposed where the population transfer between the signal levels themselves is calculated exactly, while an approximation is adopted for the transfer between the signal and the other levels. An analysis shows that the interaction of H_2O molecules with near-infrared and ultraviolet radiation will generally lead to antiinversion of the 6_{16} and 5_{23} levels, although maser pumping would be possible under a restricted (and quite unlikely) range of conditions. Pumping of strong H_2O sources (such as W49) by continuum-radiation sources is excluded by energy considerations. Collisional (or chemical) pumping is the most probable mechanism. A calculation indicates that with a normal cosmic abundance $[O]/[H]\simeq10^{-3}$ such pumping could yield the observed brightness temperatures $T_b\simeq10^{15}$°K for a number density $n_H\simeq10^9$ cm^{-3} and a kinetic temperature of several thousand degrees, but the maser radiation would have to be confined to a small solid angle $\Omega\simeq10^{-4}-10^{-5}$ sr. An isotropic maser ($\Omega=4\pi$) could ensure $T_b\simeq10^{13}$°K if it consisted primarily of active molecules and if intermolecular collisions were responsible for the pumping. The high densities and temperatures required by collisional (or chemical) pumping could be attained in shock waves propagated through dense maser clouds. (auth)

27744 PHYSICAL CONDITIONS IN THE FILAMENTS OF THE CRAB NEBULA. Golovatyi, V.V.; Pronik, V.I. (Crimean Astrophysical Observatory, Academy of Sciences of the USSR, L'vov Astronomical Observatory). Sov. Astron.-AJ 17: No. 6, 725-730 (May 1974).

The correlation between the intensities of the λλ 3727 [O II] and 4949+5007 [O III] emission lines (relative to Hβ) in the Crab Nebula filaments is discussed. An analysis of filament spectra shows that the intensities of the [O II], [O III], [Ne III], He I, and He II lines relative to Hβ vary from one filament to another in the same manner and by the same amount (on the average the intensity increases with the distance of the filament from the center of the nebula). For a steady-state model filament transparent in the Balmer lines, such a correlation between the line intensities could only result from a dispersion in the relative abundance of hydrogen and heavy-element atoms (the filaments would have a nearly normal composition at the center of the nebula, with an excess of heavy elements at the periphery). An alternative explanation of the observed correlations is briefly considered: With a normal chemical composition, nonequilibrium ionization in the filaments could also produce the observed spectra and line-intensity correlations. In this event the departure from ionization equilibrium should vary with distance of the filament from the center. (auth)

27745 ULTRAFINE STRUCTURE OF SOME COMPACT RADIO SOURCES. Matveenko, L.I.; Kogan, L.R.; Kostenko, V.I. (Institute for Space Research, Academy of Sciences of the USSR); Moiseev, I.G.; Efanov, V.A.; Clark, B.G.; Kellermann, K.I.; Grove, G.; Cohen, M.H.; Broderick, J.J.; Jauncey, D.L. Sov. Astron.-AJ 17: No. 6, 731-736 (May 1974).

Radio-interferometer observations with maximum angular resolution at λ=3.55 cm are reported for compact components of quasars and radio-galaxy nuclei. In most cases the components have a complex structure. Several components have an angular size smaller than 0".0003, with a brightness temperature $T_b>10^{12}$°K. For resolved components $T_b=10^{11}-10^{12}$°K. (auth)

27746 ANALYSIS OF THE OPTICAL RADIATION OF SCO X-1 IN THE YEARS 1967 TO 1969. Koval'chuk, G.U.; Lukatskaya, F.I. (Main Astronomical Observatory, Academy of Sciences of the Ukrainian SSR, Kiev). Sov. Astron.-AJ 17: No. 6, 741-742 (May 1974).

Autocorrelation functions are obtained for optical radiation of Sco X-1 observed in 1968 and 1969. The equation $r_\tau=e^{-\tau d/0.3}$ approximates each of them. Such an autocorrelation function equation represents the 1967 observations too. The summary distribution function of Sco X-1 radiation obtained from observations in 1967 to 1969 is approximately a Poisson distribution with parameter 2.55. The χ^2 test of fit is satisfied. Optical variations of Sco X-1 are modulated by a purely stochastic process without any periodic components except possibly periods, much more than one day. From the results of statistical analysis of its optical radiation, Sco X-1 is akin to the old novae. (auth)

27747 ATTEMPT TO MONITOR PULSED X-RAYS FROM THE CRAB PULSAR (NP 0532) UTILIZING ATMOSPHERIC FLUORESCENCE. Frederick, E. E. Athens, OH; Ohio University (1973). 215p. University Microfilms Order No. 74-7637.

Thesis (Ph. D.).

An attempt was made during the fall-winter seasons of 1971-72 to monitor the pulsed x rays from the Crab Pulsar by using a ground-based detection system. This system employed three 152-cm (60-inch) searchlight mirrors to gather a portion of the night sky light. Pulsed x rays incident upon the Earth's atmosphere are absorbed, principally by the photoelectric effect. The energetic photoelectrons in turn excite the atoms and molecules in the atmosphere in a manner similar to an auroral excitation. It is demonstrated that this atmospheric fluorescent process can follow the NP 0532 x ray waveform. No discernible signal could be established from 22 hours of data acquired by the triple mirror system. The initial signal-to-noise ratio was 10^{-4} (for three mirrors); the final signal-to-noise ratio (enhanced by signal averaging) was 0.16. This technique is not practical for monitoring; however, a much more sensitive system (> 10X) would serve as a test of the theory presented here. (RWR)

27748 NATURE OF OH MASER SOURCES ASSOCIATED WITH H II REGIONS. Burdyuzha, V.V. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 18: No. 1, 14-16 (July 1974).

From an analysis of observations and a mechanism for pumping a galactic OH maser by far-infrared radiation ($\lambda\simeq50-100$ μ), a model is proposed for maser sources associated with H II regions. A compact H II region would be surrounded by 10^4-10^5 low-mass clouds ($M\simeq10^{24}-10^{28}$ g) radiating anisotropically in the maser radio lines of OH molecule. The conditions for the origin and operation of the maser are discussed briefly. (auth)

27749 POLARIZATION OF THE 4-CM RADIATION OF VIRGO A. Soboleva, N.S. (Special Astrophysical Observatory,

Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 1, 42-43 (July 1974).

Polarimetric observations of the 4—cm radio emission of Vir A have been made with the large Pulkovo radio telescope at 1'.5 resolution. The polarized region is smaller in size than the region of unpolarized radiation, and the maximum of the polarized radiation is shifted to the east of the unpolarized maximum. The electron density within the polarized region is estimated. (auth)

27750 INFRARED PUMPING PROCESSES FOR SiO MASERS. Geballe, T.R.; Townes, C.H. (Department of Physics, University of California, Berkeley). Astrophys. J. Lett. 191: No. 1, L37-L41 (1 July 1974).

The $J=2\rightarrow1$ transition of the first excited vibrational state ($v=1$) of $^{28}Si^{16}O$ has recently been shown to produce maser amplification near 86,245 MHz in Orion A and in several stars. Two possible pumping mechanisms are proposed for such masers. One involves the near coincidence between the frequencies of the 1—0 (R0) and 3—2 (R18) transitions in $^{28}Si^{16}O$. The other requires emission by SiO and reabsorption without the necessity for an accidental frequency coincidence. Each of these types of mechanisms may occur for other transitions of molecules in a medium illuminated by intense infrared radiation, or with strong temperature gradients. (auth)

27751 OBSERVATION OF AN ABSORPTION DIP IN THE X—RAY INTENSITY OF CYGNUS X—1. Li, F.K.; Clark, G.W. (Massachusetts Institute of Technology, Center for Space Research). Astrophys. J. Lett. 191: No. 1, L27-L29 (1 July 1974).

On 1973 January 2 the MIT X—ray detectors on the OSO—7 satellite recorded a transient change in the X—ray spectrum on Cygnus X—1 indicative of an increase which lasted at least 37 minutes and occurred at a time near phase zero of the secondary of the likely optical counterpart, the spectroscopic binary system HD 226868. The effect is interpreted as a partial occultation by a stream of matter passing in front of the X—ray source and having a column density along the line of sight equivalent to $\sim 2\times10^{22}$ H atoms cm^2 of cold matter. (auth)

27752 APSIDAL MOTION AND PERIOD CHANGES IN CENTAURUS X—3. Thomas, H. (Max—Planck—Institut für Physik und Astrophysik, München). Astrophys. J. Lett. 191: No. 1, L25-L26 (1 July 1974).

Apsidal motion is suggested to explain the observed period changes in Cen X—3. Theoretically derived apsidal—motion periods do not contradict the observations made so far; the eccentricity needed to produce large enough period changes is small (below 3%). (auth)

27753 SPECTROSCOPIC STUDIES OF A SUGGESTED OPTICAL CANDIDATE FOR CENTAURUS X—3. Vidal, N. V.; Wickramasinghe, D.T.; Peterson, B.A.; Bessell, M.S. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University). Astrophys. J. Lett. 191: No. 1, L23-L24 (1 July 1974).

Krzeminsky's optical candidate for Cen X—3 is found to be an OB star with varying emission lines at λλ4200, 4640, and 4686. Hβ and λ4686 show P Cygni profiles indicating an expansion velocity of about 800 km s^{-1}. A tentative spectral type of O9 III—V is suggested. Distance, X—ray luminosity, and mass are discussed. (auth)

27754 THE SIGNIFICANCE OF RADIO FLUX VARIATIONS IN PKS 0735+178. Jones, T.W. (Department of Physics, University of California, San Diego). Astrophys. J. Lett. 191: No. 1, L15-L17 (1 July 1974).

The flux variations at 10.7 GHz reported by Medd et al. for the compact radio source PKS 0735+178 are examined in the light of the recent redshift determination by Carswell et al. of the associated optical object. It is shown that the angular radius of the radio source at 10.7 GHz must be at least as large as 0·0002—0·0003 if the emission is incoherent electron synchrotron from isotropic electrons, and that, if the redshift is cosmological, the most rapid flux variations correspond to changes in no more than about 1/15 the light travel time across the source. The implications are briefly discussed. (auth)

27755 SPECTRA MEASUREMENTS OF A COSMIC GAMMA—RAY BURST WITH FAST TIME RESOLUTION. Imhof, W.L.; Nakano, G.H.; Johnson, R.G.; Kilner, J.R.; Reagan, J.B. (Lockheed Palo Alto Research Laboratory); Klebesadel, R.W.; Strong, I.B. Astrophys. J. Lett. 191: No. 1, L7-L10 (1 July 1974).

A γ—ray burst on 1972 December 18 identified by the Vela satellite system has been observed with a 50 cm^3 germanium spectrometer on board the low—altitude polar orbiting satellite, 1972—076B. Two pronounced and narrow (~60 ms duration) microbursts with trailers (i.e., higher intensities after the microburst than before) were observed during the period prior to the Vela trigger, and evidence for at least five microbursts occurring within 1.8 s is presented. The spectrum is harder during the most intense microburst prior to the Vela trigger, and the spectrum softens at later times. (auth)

27756 ON THE SYSTEMATIC OPTICAL IDENTIFICATION OF THE REMAINING 3C RADIO SOURCES. I. A SEARCH IN 47 FIELDS. Kristian, J.; Sandage, A.; Katem, B. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J. 191: No. 1, 43-50 (1 July 1974).

Forty—seven 3CR radio sources that were either unidentified or identified only provisionally are investigated, mostly to fainter limits than the Palomar Sky Survey. New plates, taken with the Palomar 48—inch (1.2—m) Schmidt or the 200—inch (5—m) Hale reflector, were measured for positions of objects near each radio position. Optical identifications are made on the basis of positional coincidence alone to within ~3 σ of the combined radio and optical errors, which is of order ~ ± 4″ for most fields. Of the 47 fields, positive identifications are made for 19 objects; possible or probable identifications for 7; and 21 are still empty to the limit of our best optical material. Most of the 26 positive or probable identifications are galaxies. Of these, 10 are in groups or clusters: the best cases are 3C 268.3, 299, 324, 330, and 337. Only four probable quasar candidates (3C 36, 272, 321, and 418) are among the 26 cases. Previously suggested identifications for 3C 36, 68.2, 99, 114, 124, 175.1, 210, 228, 263.1, 289, and 356 are shown to be unlikely on the basis of positional disagreement. Optical positions of the 26 new candidates and other stars in the fields are given. No spectroscopy or photometry is given for any of the candidates except 3C 460, where a low—spectral—resolution scan gave $z=0.27\pm0.02$ for the identified E5 galaxy. (auth)

27757 BL LACERTAE (VRO 42.22.01): SIMULTANEOUS RADIO AND OPTICAL OBSERVATIONS. Andrew, B.H.; Harvey, G.A.; Medd, W.J. (National Research Council, Ottawa, Canada); Hackney, K.R.; Hackney, R.L.; Scott, R.L.; Smith, A.G.; Leacock, R.J.; McGimsey, B.Q.; Epstein, E.E.; Montgomery, J.W.; Mottmann, J.; Pomphrey, R.B. Astrophys. J. 191: No. 1, 51-54 (1 July 1974).

During 1972 August and September simultaneous optical and radio observations were made of BL Lac (VRO 42.22.01) in an attempt to find correlated variations. The optical and radio variations have similar time scales, but the evidence for correlation is inconclusive. The rapid variations at radio wavelengths are highly polarized and seem to originate in a region which is optically thin and has a highly ordered magnetic field. (auth)

27758 ASTROPHYSICAL MASERS. V. PUMP MECHANISMS FOR H_2O MASERS. Goldreich, P.; Kwan, J. (California Institute of Technology, Pasadena). Astrophys. J. 191: No. 1, 93-100 (1 July 1974).

The problem of determining the pump mechanism for strong H_2O masers is considered. It is shown that for every class of pump models, very general constraints may be placed on the maser size and luminosity. A careful evaluation of these constraints indicates that collisional pumps and external radiative pumps are unlikely to account for the strong H_2O masers associated with HII regions. It is proposed that these sources are powered by a hot—dust, cool—gas, internal radiative pump. Specifically, the pump mechanism involves the absorption by the H_2O molecules of 6.3—μ photons which are emitted by the hot dust grains. These absorptions produce transitions from the rotational levels of the ground vibrational state to the rotational levels of the first—excited vibrational state. The pump action results because there are more absorptions per degenerate sublevel from the 5_{23} level than from the 6_{16} level. The heat sink in this pump model is provided by the cool H_2 molecules which collisionally de—excite the H_2O molecules from the first—excited vibrational state to the ground vibrational state. The hot—dust, cool—gas pump model can operate only in the vicinity of a highly luminous, variable star. The variation in temperature of the dust grains which are heated by the radiation from the star is essential to prevent the dust and gas from coming into thermal equilibrium. One feature of this pump model is that at any point the dust temperature must vary from below to above the gas temperature. Thus, the strong intensity variations observed in H_2O masers find a natural explanation in the model. (auth)

27759 ON THE PASSAGE OF RADIATION THROUGH INHOMOGENEOUS, MOVING MEDIA. IV. RADIATIVE TRANSFER UNDER SINGLE—PARTICLE COMPTON SCATTERING. Lerche, I. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois 60637). Astrophys. J. 191: No. 1, 191-199 (1 July 1974).

The equation of radiative transfer for a rapidly moving, differentially, shearing medium is given under the assumption of independent particle Compton scattering. Using first a Mellin transform and then an extension of an approximation procedure most explicitly developed by Chandrasekhar, we illustrate how the specific intensity of the radiation field is amplified in an ever—decreasing angular width with respect to the flow direction as the medium speed increases. These results are of interest in connection with the propagation of pulsed signals through the differentially shearing magnetosphere of a pulsar—a particular concern being the spatial vicinity near the "speed—of—light" circle where large differential shear must obtain. (auth)

27760 PULSAR–SUPERNOVA–REMNANT PAIRS AND THE GALACTIC GRAVITATIONAL FIELD. Jones, E.M. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Astrophys. J. 191: No. 1, 207-209 (1 July 1974).

It is shown that the supernova remnant HB 21 is probably well past the blast–wave stage of evolution and is undergoing buoyant motion and deformation. It is proposed that measurement of pulsar proper motions may be fruitful, in that they would help establish the existence of new pairs and, in the cases of HB 21/PSR 2021+51 and W28/PSR 1749–28, would provide a means of estimating the galactic gravitational field. (auth)

27761 OPTICAL PROPERTIES OF HZ HERCULIS. Bahcall, J.N.; Joss, P.C.; Avni, Y. (The Institute for Advanced Study, Princeton, New Jersey). Astrophys. J. 191: No. 1, 211-219 (1 July 1974).

The optical properties of HZ Her are analyzed, and several parameters of the Her X–1–HZ Her binary system are estimated. The phase agreement of the X–ray and optical variations, the dependence of the average optical luminosity upon the 35–day X–ray cycle, and the energy budget of the optical variations are studied, using recent observational data. The period, amplitude, and phase of the small–scale optical light variations found by Jones et al. during times of extended optical inactivity are also investigated. The light curve and the radial–velocity variations of HZ Her are analyzed, using several simple models for the brightness distribution across the face of the star. The masses of Her X–1 and HZ Her are estimated by four different methods. (auth)

27762 SHORT–TIME OPTICAL VARIABILITY OF X–RAY SOURCES. Avni, Y.; Bahcall, J.N. (Institute for Advanced Study, Princeton, New Jersey 08540). Astrophys. J. 191: No. 1, 221-230 (1 July 1974).

A formalism for interpreting the short–time optical variability caused by X–ray heating in variable X–ray sources is presented and applied to the following systems: Her X–1, Cen X–3, Cyg X–1, 2U 0900–40, 2U 1700–37, Sco X–1, and Cyg X–2. It is shown that the observed upper limit of 0.03 percent to regular optical pulsations from HZ Her can be understood if the time to convert X–ray energy to emitted optical light is of the order of 10 seconds or longer. An upper limit of 3 percent is derived for an rapid optical variability from the optical companions of 2U 0900–40, 2U 1700–37, and Cyg X–1; the expected fluctuations of optical light from HDE 226868 are less than 3×10^{-4} if the X–ray variability of Cyg X–1 has a shot–noise character. (auth)

27763 VARIABILITY OF MID–LATITUDE MAGNETIC PARAMETERS USED TO CHARACTERIZE MAGNETOSPHERIC SUBSTORMS. Clauer, C.R.; McPherron, R.L. (Department of Planetary and Space Science and Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California 90024). J. Geophys. Res. 79: No. 19, 2898-2900 (1 July 1974).

In another paper we showed how mid–latitude magnetograms could be used to derive quantitative parameters that describe a magnetospheric substorm (Clauer and McPherron, 1974). These parameters include the onset time of the magnetospheric substorm expansion, the meridian of first onset, the central meridian of the resulting expansion observed at mid–latitudes, and the extent of the event in local time. In this paper we report the results of determining these parameters for a group of 45 magnetospheric substorms. Each event selected was isolated and well defined at mid–latitude and occurred during periods of auroral zone magnetic activity. We find that the magnitude, central meridian, and extent of the magnetospheric substorm are highly variable. We interpret our results in terms of a simple field–aligned diversion of the tail current through the auroral ionosphere. Our results suggest that this field–aligned circuit can form at any local time in the night sector. Past controversy concerning the magnetospheric signature of magnetospheric substorms may, in part, be a consequence of negelecting this aspect of substorm behavior. For example, the finite extent of the disturbance at mid–latitudes suggests that a limited longitudinal sector of the tail is involved, and the variability of central meridians suggests that this sector may occur in different positions across the tail. (auth)

27764 A SEARCH FOR MOLECULAR HYDROGEN IN QUASAR ABSORPTION SPECTRA. Aaronson, M.; Black, J.H.; McKee, C.F. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. Lett. 191: No. 2, L53-L56 (15 July 1974).

Quasar absorption spectra have been searched for H_2 lines. The possible presence of these lines in the z=2.31 system of PHL 957 is discussed. Analysis of the formation and destruction of H_2 shows that confirmation of this system or of one found by Carlson would establish the cosmological origin of the lines. (auth)

27765 A HIGH–SENSITIVITY PULSAR SURVEY. Hulse, R.A.; Taylor, J.H. (Department of Physics and Astronomy, University of Massachusetts, Amherst). Astrophys. J. Lett. 191: No. 2, L59-L61 (15 July 1974).

Eleven new pulsars have been detected in the initial stages of a low–latitude pulsar survey being carried out at the Arecibo Observatory. The survey is more than 10 times more sensitive than previous pulsar surveys, and has at present covered 7 percent of the sky within 5° of the galactic plane accessible to the Arecibo telescope. The results suggest that the density of pulsars in the Galaxy decreases rapidly for distance greater than 10 kpc from the galactic center. (auth)

27766 PERIOD IRREGULARITIES IN PULSARS. Manchester, R.N.; Taylor, J.H. (Department of Physics and Astronomy, University of Massachusetts, Amherst). Astrophys. J. Lett. 191: No. 2, L63-L65 (15 July 1974).

Period irregularities have been detected in pulsars with periods longer than 0.1 s. A discontinuous decrease in the period of PSR 1508+55 occurred near the end of 1972 in which the fractional change of rotation freqency was $\sim2\times10^{-10}$. Subsequent to the event, the period derivative apparently relaxed to a new value approximately 0.5 percent less than the original value. Random changes in period, apparently similar to those observed in the Crab Nebula pulsar, have been observed in PSR 1642–03 and PSR 0329+54, but not in PSR 1919+21. (auth)

27767 X–RAY OBSERVATIONS OF THE SUPERNOVA REMNANT IC 443. Winkler, P.F. Jr.; Clark, G.W. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology, Cambridge). Astrophys. J. Lett. 191: No. 2, L67-L69 (15 July 1974).

Observations by OSO–7 positively identify IC 443 as a source of X–rays at energies of 1–10 keV. Spectral data are fitted equally well by a steep power law or by thermal bremsstrahlung at $T=17\times10^{6}$°K. This temperature and the shock–wave model lead to an age of 3400 years for IC 443, much younger than previous estimates. (auth)

27768 OBERVATIONS OF CIRCINUS X–1 FROM UHURU. Jones, C.; Giacconi, R.; Forman, W.; Tananbaum, H. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory, Cambridge, Massachusetts). Astrophys. J. Lett. 191: No. 2, L71-L74 (15 July 1974).

Analysis of Uhuru observations of the X–ray source Cir X–1 (3U 1516–56) suggests that the source may be a binary with a period longer than $15^{d}.0$. Significant intensity variations have been observed on all time scales from 0.1 s to days. Changes in the X–ray energy spectrum from 2 to 20 keV also have been found. A refined X–ray position, containing no obvious optical counterpart, is also reported. The similarities between Cyg X–1 and Cir X–1 suggest that the X–rays from Cir X–1 also may be produced by accretion onto a massive, collapsed object. (auth)

27769 OSO–7 OBSERVATIONS OF CIRCINUS X–1. Canizares, C.R.; Li, F.K.; Clark, G.W. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology, Cambridge). Astrophys. J. Lett. 191: No. 2, L75-L76 (15 July 1974).

We present data from six observations with the MIT X–ray detectors on the OSO–7. The results for one 5^{d} interval rule out the $12^{d}.288$ binary eclipse period proposed by Jones, Tananbaum, and Giacconi for this source. The average spectrum is considerably steeper than those of the established eclipsing binaries. (auth)

27770 FORMALDEHYDE LINE EMISSION AT 4.8 GHz NEAR NGC 7538. Downes, D.; Wilson, T.L. (Max–Planck–Institut für Radioastronomie, Bonn). Astrophys. J. Lett. 191: No. 2, L77-L78 (15 July 1974).

Emission–line features of formaldehyde have been detected at 4.8 GHz in the direction of the compact radio and infrared nebulae near the H II region NGC 7538. The H_2CO emission probably comes from a shell of cool dust and gas surrounding the compact ionized regions. (auth)

27771 REDSHIFT OF 1548 + 115a AND 1548 + 115b IN THE THEORY OF THE GENERALISED GRAVITATIONAL POTENTIAL. Cherry, N. H. (University City Science Centre, Philadelphia). Nature (London); 250: No. 5362, 127-128(12 Jul 1974).

Reference is made to Wampler and others (Nature 246:203 (1973)) who reported that the red shift of 1548 + 115a is z = 0.4359 and that of 1548 + 115b is 1.901. Since these QSOs are separated by only about 5 arc sec it was concluded that they are at the same cosmological distance and that the red shift must be regarded as "discordant." The present author applies the theory of the generalized gravitational potential to this pair of objects, and assumes a negligible gravitational factor for 1158 + 115a. The total red shift then represents the recessional red shift for both objects, and the results are close to those of Wampler. (UK)

Solar Phenomena

Refer also to abstracts 26668, 26896, 27897, 27919, 27934, 28015, and 28223.

27772 (AD-733662) SOLAR FLUX, AND TOTAL PARTICLE AND O_2 DENSITY, IN UPPER ATMOSPHERE. Grobecker, A. J. (Institute for Defense Analyses, Arlington, Va. (USA). Science and Technology Div.). Sep 1971. Contract DAHC15-67-C-0011. 94p. (P-695; IDA/HQ-70-11860). NTIS $3.00.

Solar flux, and total particle and O_2 density distribution, in the upper mesosphere and lower thermosphere (70- to 150-km region) are described. Respective distributions were determined from solar flux intensities measured by ion chambers in three rocket vehicles launched on 21 February 1966 from North America (two at Eglin Gulf Test Range, Florida, and one at Fort Churchill, Manitoba). Method of determining density distributions is given. Solar flux outside and inside the absorbing atmosphere was measured for the following wave bands: 1-20A (x ray), 1140-1260A (mainly hydrogen Lyman-alpha line at 1215.6A), and 1325-1475A (Schumann-Runge continuum). Distributions of O_2 and total particle density are based on the solar flux absorption in the sensible atmosphere. Results of solar flux measurements compare, in general, with results obtained elsewhere. Estimated errors vary from 10 to 100 percent. Density results also agree generally with those of other experimenters (using similar or other techniques), except for one striking difference: a step of O_2 density exists at 113 plus or minus 7 km altitudes. This step, which to one's knowledge has not been reported elsewhere, is described theoretically. Its existence is also confirmed by electron density data derived by ionosonde at each launch site. (auth)

27773 (AD-737789) 27-DAY VARIATION OF SOLAR ACTIVITY, COSMIC-RAY INTENSITY AND GEOMAGNETIC ACTIVITY. Final Scientific Report. Dyring, E. (Uppsala Univ. (Sweden). Fysiska Institutionen). 1 Sep 1971. Contract F61052-68-C-0034. 14p. (UU/CRG-71-5; AFCRL-71-541). NTIS $3.00.

Zurich relative sunspot numbers, 10.7 cm solar radio flux, cosmic ray neutron monitor intensities and geomagnetic A (p)-data during 1958–1969 and geomagnetic K (p)-data during 1932–1969 have been analyzed by use of time series methods to study variations with periods 5–40 days and correlations between the parameters. All the parameters show a 27-day variation. For the cosmic ray intensity and the geomagnetic activity this variation is dependent of the solar cycle. By use of filtering techniques the cosmic ray intensity and the geomagnetic activity are studied on individual solar rotations for 1958–1969. From power spectrum analysis on geomagnetic K (p)-data 1932–1969 higher harmonics of the 27-day period are generally found. For many years there exist a 13.5-day variation with a magnitude excluding it to be an effect of the mathematical treatment. The effect may tentatively be related to the active longitudes on the sun. (auth)

27774 (AD-772710) RELATIVE CORONAL ABUNDANCES DERIVED FROM X-RAY OBSERVATIONS OF SODIUM, MAGNESIUM, ALUMINUM, SILICON, SULFUR, AND ARGON. Report for July 1969–July 1973. Walker, A. B. C. Jr.; Rugge, H. R.; Weiss, K. (Aerospace Corp., El Segundo, Calif. (USA)). 21 Nov 1973. Contract F04701-73-C-0074. 57p. (SAMSO-TR-73-398). NTIS $3.75.

The coronal spectrum between 3.5 and 8.5 A and several levels of coronal activity were observed, and absolute fluxes for 79 lines and for the continuum were determined. Identifications have been determined for the majority of the lines observed, and in particular for the resonance lines of Mg XI, Mg XII, Al XII, Al XIII, Si XIII, Si XIV, S XV and S XVI. The measured fluxes of these lines have been used to construct a model of the temperature dependence of the coronal emission measure between 1.5 and 10×10 to the 6th power K. This model is used to determine the relative abundances of Mg, Al, Si, and S. The relative abundances of Ar and Na were also computed, using the observed intensities of weak lines of these two elements. (GRA)

27775 (AD-774021) EVOLUTION OF SOLAR ACTIVE REGIONS BASED ON 8.6 mm AND OTHER SOLAR OBSERVATIONS. Final Report, 1 January–30 June 1973. Vernazza, J. E.; Withbroe, G. L. (Harvard Coll. Observatory, Cambridge, Mass. (USA)). Jul 1973. Contract F19628-73-C-0141. 34p. (AFCRL-TR-73-0643). NTIS $4.75.

Extreme ultraviolet (EUV) and radio (8.6 mm) observations have been analyzed in order to obtain information about the chromospheric layers of solar quiet and active regions. Correlations between EUV lines, EUV continua and 8.6 mm radiation have been obtained. On the basis of these correlations and theoretical considerations it is suggested that as a first approximation EUV chromospheric lines are formed at the same temperatures in quiet and active regions. The increased density in active regions causes an increase in EUV chromospheric emission through a reduction in the non-LTE departure coefficients. The 8 mm brightness temperature increases in active regions because the larger optical depth causes the 8 mm radiation to be emitted from higher and hotter layers in active regions than in quiet regions. A good correlation is also found between the flaring rate of active regions and their 8 mm brightness temperatures. (auth) (GRA)

27776 (AD-774918) STUDY OF THE MEAN SOLAR MAGNETIC FIELD. Scherrer, P. H. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Dec 1973. Contract N00014-67-A-0112-0068. 161p. (SU-IPR-554). NTIS $5.00.

The magnetic field of the sun seen as a star has been observed at the Mount Wilson Observatory. The sun-as-a-star field, or mean field, as measured in integrated sunlight has been compared with both large scale averages of conventional solar magnetic maps and the interplanetary magnetic field observed near the earth. Three somewhat independent topics concerning the "mean field" observations and interpretation are discussed: The relation between the mean field observations and models of large scale solar magnetic structure, the nature of the comparison of the mean field with the interplanetary field, and the relative contribution of fields on different parts of the solar disk to the mean field. The relationship between the observed large scale magnetic structure and models of the solar field is discussed in terms of the "Babcock–Leighton" and "sector" models. (GRA)

27777 (AD-775215) RELATIONSHIP BETWEEN THE SLOWLY VARYING COMPONENT OF SOLAR RADIO EMISSION AND LARGE SCALE PHOTOSPHERIC MAGNETIC FIELD PATTERNS. Scherrer, P. H.; El-Raey, M. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Dec 1973. Contract N00014-67-A-0112-0068. 19p. (SU-IPR-556). NTIS $4.00.

Daily solar radio flux observations have been examined for a relationship to the large-scale photospheric magnetic field structure. Interplanetary magnetic field sector boundaries were used to indicate boundaries between photospheric field regions of opposite polarity. An enhancement in emission was found about four days before the boundary central meridian passage. Most of the effect came from emission near toward-to-away type boundaries. A higher level of emission appears to be associated with toward field regions than with away field regions. (auth)

27778 (IPPJ-DT-37) SPACE–PLASMA PROBLEMS. Jordan, H. L. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1972. 40p. INIS.

Problems concerning the plasma in interplanetary space are described. Particles in the space are coming from solar surface. First, solar data, that is, distance from the center of galaxy, rotational speed, mass, radius, escape speed and so on are given. Solar atmosphere is explained, which is divided into three regions, photosphere, chromosphere and corona. Solar flare is a complex event resulting in a variety of different processes as radio-emission, ultra-violet radiation, x-ray, cosmic ray, etc. The sun is rotating about its geometric axis with the period of 25.2 days. Due to the rotation of the sun and other processes, particles are ejected in the space all around. The particles move on magnetic field lines. Because of the sun's rotation, the magnetic field lines and trajectories of the particles are curved. Sector-structure, co-rotation, micro structure, local neutral layer shocks and local moving shocks are described concerning the magnetic field and the ejected particles. Formation of stars and solar interior model are explained. Discussion concerning sun spots and the flare are presented. Concerning the interaction of solar wind, origin of the solar wind, escape velocity, solar wind-supersonic flow, magnetic storm, magnetopause (location of boundary), shape of the magnetosphere, boundary layer, geomagnetic tail, instability, acceleration process of the particles, radiation belt, and sources of high energy particles are discussed. Study on the space plasma problems proves to be useful on laboratory scale provided proper scaling. Then, a brief discussion is given, and Kawashima's experiment, influences of external field and distribution of the magnetic field are described. (INIS)

27779 THE WIDTHS OF THE SOLAR He I AND He II LINES AT 584, 537, AND 304 Å. Doschek, G.A. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D.C. 20375); Behring, W.E.; Feldman, U. Astrophys. J. Lett. 190: No. 3, L141-L142 (15 June 1974).

In this Letter we report direct measurements from a rocket spectrograph of the widths of the solar He I lines, $1s^2 - 1s2p$ and $1s^2 - 1s3p$, at 584 and 537 Å. We also report the width of the solar resonance line of He II at 304 Å. The deduced full widths at half–maximum intensity are 0.14, 0.12, and 0.10 Å for the 584, 537, and 304 Å lines, respectively. These widths represent averages over the entire Sun. Line profiles corrected for the nonlinear film response are presented for the 584 and 304 Å lines. (auth)

27780 DYNAMICS OF THE SOLAR MAGNETIC FIELD. III. LOCATION OF SOLAR–FLARE EXCITATION AND THE VELOCITY FIELD DETERMINED FROM MAGNETOGRAMS. Levine, R.H.; Nakagawa, Y. (High Altitude Observatory, National

Center for Atmospheric Research, Boulder, Colorado). Astrophys. J. 190: No. 3, 703-709 (15 June 1974).

The velocity field comparable with the relative motions of sunspots is determined from consecutive magnetograms of a fine quality obtained near the disk center of the Sun during 1972 August 2–4 (courtesy of the Kitt Peak National Observatory) using the method suggested previously by Nakagawa. The velocity fields show relative motions of sunspots in agreement with those deduced from white–light photographs. Further it is shown that the most likely positions of initial flare activity correspond to locations where a local maximum in the rate of strain of the velocity field coincides with either zero gradient (maxima and saddle points) or zero value (neutral lines) of the vertical magnetic field. The detailed manner of determination is described together with discussions of the physical significance of the results. (auth)

27781 DYNAMICS OF THE SOLAR MAGNETIC FIELD. IV. EXAMPLES OF FORCE–FREE MAGNETIC–FIELD EVOLUTION IN RESPONSE TO PHOTOSPHERIC MOTIONS. Nakagawa, Y.; Tanaka, K. (High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado). Astrophys. J. 190: No. 3, 711-714 (15 June 1974).

The evolution of force–free magnetic fields in the solar atmosphere in response to photospheric motions is examined utilizing the method developed by Nakagawa. With linear dipole magnetic fields it is shown that for a photospheric motion which increases general shear, the magnetic field evolves to produce open field lines leading to the formation of a "magnetic bubble," and that for a motion which reduces general shear, the evolution is characterized by the presence of flat field lines. The details of the analysis and the results of physical significance, particularly in interpreting observations, are discussed. (auth)

27782 OBSERVATION OF TRANSIRON SOLAR–FLARE NUCLEI IN AN APOLLO 16 COMMAND–MODULE WINDOW. Shirk, E.K. (Department of Physics, University of California, Berkeley, California 94720). Astrophys. J. 190: No. 3, 695-702 (15 June 1974).

Transiron nuclei from the 1972 April 18 solar flare have been detected in one of the Apollo 16 command–module windows. Measurements of 39 events with $Z \geq 32$ and of 12 events with $Z \geq 44$ have been completed. The enhancement factor Q(Z/Fe) $\equiv [Z/Fe]_\odot / [Z/Fe]_\phi$ is found to be $Q(Z \geq 32/Fe) = 40(+40, -20)$ at $0.3 \lesssim E \lesssim 1$ MeV amu^{-1} and $Q(Z \geq 44/Fe) = 120(+120, -60)$ at $0.6 \lesssim E \lesssim 2$ MeV amu^{-1}. (auth)

27783 ENERGY BALANCE IN THE SOLAR CORONA. Dubov, E.E. (Crimean Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 6, 837-838 (May 1974).

Radiative cooling plays an insignificant role in establishing the value of the maximum temperature in the corona, which can vary widely depending on the energy flux in mechanical waves. From the energy–balance standpoint a fairly thick layer with $T \simeq 5 \cdot 10^6$°K probably exists below the corona and transition layer. (auth)

27784 TYPE II SOLAR RADIO BURST WITH PATCH STRUCTURE. Korolev, O.S.; Markeev, A.K.; Fomichev, V.V.; Chertok, I.M. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio–Wave Propagation, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 6, 776-780 (May 1974).

The properties of the patch structure in the dynamic spectra of eight type II bursts observed at 45–90 MHz are analyzed. Mean values are determined for the parameters of the individual structural elements: In the frequency ranges 90–70 and 70–45 MHz, the duration was 2.1 and 3.4 sec, and the bandwidth 1.9 and 2.3 MHz, respectively. Several models for the generation of this structure are discussed. (auth)

27785 A MECHANISM FOR GENERATING TYPE IV SOLAR RADIO BURSTS. Stepanov, A.V. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio–Wave Propagation, Siberian Branch, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 6, 781-787 (May 1974).

A coherent plasma mechanism is proposed for the radio emission of moving type IV bursts with an arcuate structure. The source at the top of the arch (at the center of the magnetic trap) radiates at a frequency of $\simeq 2\omega_L$ and is produced by the instability of two opposing beams moving along the trap. This mechanism is analogous to the one accepted for type V bursts. At the base of the arch, near the magnetic–mirror points of the trap, longitudinal waves are excited at the upper hybrid frequency because of loss–cone instability. Interaction of these waves yields electromagnetic radiation of frequency $\simeq 2(\omega_L^2 + \omega_H^2)^{1/2}$. The observed polarization of the sources at the base of the arch corresponding to the ordinary wave results from a preferential absorption of extraordinary waves on the third gyroresonance level. This circumstance requires that $\omega_L/\omega_H \simeq 1$. The proposed mechanism affords estimates for the radio intensity and field strength in the corona; they are consistent with the observational data. (auth)

27786 UNUSUAL SOLAR METER RADIO BURSTS. Chernov, G.P. (Institute of Terrestrial Magnetism, the Ionsphere, and Radio–Wave Propagation, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 6, 788-792 (May 1974).

High–resolution observations of unclassified solar radio bursts in the range 195–220 MHz during 1969–1970 are reported. There are several forms of "spikes" (transient bursts with an instanteous bandwidth of $\simeq$ 1–1.5 MHz and a duration of $\simeq$ 0.1 sec at a fixed frequency) as well as groups of spikes comprising four or five bursts within 1 sec, forming bands of "rain" structure in the dynamic spectrum. A plasma mechanism for generating them is discussed. If the velocity distribution along a beam of fast particles is nonmonotonic, the beam can momentarily radiate plasma waves over a wide frequency range and then be extinguished after a time $\tau = \gamma^{-1}$ (where γ^i is the growth rate for plasma oscillations), an event corresponding to an instantaneous spike; or it can emit a narrow band of radiation with a drift in frequency, corresponding to a drifting spike. Not only double but also triple bursts have been observed whose components have opposing frequency drifts. (auth)

27787 QUALITATIVE SOLUTION OF THE COAGULATION EQUATION WITH ALLOWANCE FOR FRAGMENTATION. Zvyagina, E.V.; Pechernikova, G.V.; Safronov, V.S. (Institute of Terrestrial Physics, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 6, 793-800 (May 1974).

A qualitative analysis is given of the coagulation equation describing the accumulation of protoplanetary bodies, with allowance for fragmentation through collisions between bodies of comparable size. A condition is derived for the disintegration of a gravitating body of mass m_2 in collision with another body of smaller mass m_1. If the bodies are not too massive this condition may be approximated by a relation of the form $\alpha = m_1/m'' \propto m''^{\lambda}$, where $m'' = m_1 + m_2$. In accordance with experimental evidence, the mass distribution of the fragmentation products is assumed to follow an inverse power law with exponent $q_1 \simeq 1.8$. Asymptotic solutions of the coagulation equation including fragmentation are derived by a method developed previously for the case with no fragmentation, and their stability is investigated. The solutions can satisfactorily be approximated by an inverse power law with exponent $q \simeq 1.8$ over the entire range of m values, except for the few largest bodies. A study is made of how the exponent in the power–law asymptotic distribution depends on various parameters, such as the coagulation coefficient, the fragmentation process, and the size of the largest fragments. The asymptotic solutions obtained by Dohnanyi, Hellyer, and Bandermann for the asteroid mass distribution are here derived as a special case, where there is no accumulation but only fragmentation. These authors' solution with $q = 11/6$ can be obtained only by assuming that the fragmentation condition is independent of the mass of the bodies ($\lambda = 0$). Evidence is given that actually $\lambda \simeq 2/3$. The agreement with the results of others lends support to our approach. The method offers promise for analyzing the complicated equations that simultaneously describe the accumulation and fragmentation of bodies. (auth)

27788 INFLUENCE OF TRANSVERSE MAGNETIC FIELDS ON POLARIZED RADIO EMISSIONS FROM SOLAR LOCAL SOURCES. Peterova, N.G.; Akhmedov, S.B. (Leningrad Branch, Special Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 6, 768-775 (May 1974).

From observations with the large Pulkovo radiotelescope at cm wavelengths (resolution 1–3') it has been discovered that a change in the sign of polarization occurs in over 50% of local sources of s–component radio emission on the sun upon transition from one hemisphere to the other. Most often, the change in the sign of polarization is accompanied by a decrease in circularly polarized radiation at short wavelengths. The change in the sense of polarization is explained by the effect of propagation conditions in the well known theory of wave interaction in regions with transverse magnetic fields. It is shown that the spectral peculiarities of the polarization change together with information on localization within the solar atmosphere of sources of polarized cm wavelength radiation may be used for study of the three–dimensional structure of the magnetic field in the active region. From observations of one local source, the distance to the region of radiation interaction with the transverse field is determined and the structure of the field calculated. The structure agrees qualitatively with known concepts of sunspot magnetic fields, in particular, with the concept of needle–like structure of such fields. It is concluded that for many local sources, that a combination of physical parameters is achieved in which short–wave circularly polarized radiation is converted to linearly polarized radiation. (auth)

27789 INSTABILITY OF QUIESCENT PROMINENCES AND THE ORIGIN OF SOLAR FLARES. Pustil'nik, L.A. (Special Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 6, 763-767 (May 1974).

A balloon mode for the trough instability in a quiescent prominence (filament) is examined. The small thickness of quiescent prominences is explained on the basis of the results obtained, the stationary stage of their evolution is described, and a model is proposed for the origin of solar flares. (auth)

27790 INTERSTELLAR MOLECULES. Winnewisser, G.; Mezger, P. G. (Max-Planck-Institut fuer Radioastronomie, Bonn). pp 1-81 of Cosmochemistry. Boschke, F. (ed.). New York; Springer-Verlag (1974).

The following topics are discussed: molecules as probes of interstellar space; interstellar space and interstellar matter, observations of interstellar molecules; and formation and destruction of molecules in interstellar space. (LBS)

27791 CENTRE TO LIMB BRIGHTNESS DISTRIBUTION AT RADIOFREQUENCIES: RESULTS OF THE TOTAL SOLAR ECLIPSE OF NOVEMBER 12, 1966. Chiuderi Drago, F.; Patriarchi, P. (Arcetri, Osservatori Astrofisico, Florence). Soc. Astron. Ital., Mem.; 44: 321-327(1973).

The records of the total solar eclipse of Nov. 12, 1966, are studied at seven radio frequencies between 3 and 21 cm. The aim of this work is to determine the presence of the equatorial limb brightening and its intensity. The presence of some active regions near the limbs and the uncertainties on the records do not allow a unique determination of the above quantity at long wavelengths. At short wavelengths (about 3 to 4 cm) the presence of a strong brightening must be excluded and the best agreement with observations is obtained assuming a uniform disk. This is in conflict with all theoretical results obtained assuming homogeneous models of the solar atmosphere. (auth)

27792 PHYSICAL CHARACTERISTICS OF THE SOLAR ATMOSPHERE. Kuperus, M. (Rijksuniversiteit Utrecht, Netherlands). pp 89-117 of Summer School on Plasma Physics and Solar Radioastronomy. Vol. 1. Mangeney, A. (ed.). Meudon, France; Observatoire de Paris-Meudon (1973).

From proceedings of the summer school on plasma physics and solar radioastronomy; Ile de Re, France (4 Sep 1972).

After a brief description of the solar atmosphere, convection phenomena and wave motion excitation in the upper convection zone are described. The physical properties of the solar corona are analyzed: ionization state, radiative processes, density, temperature, magnetic field, electron density distribution, heating processes, and solar wind. The origin of the 11-year cycle is discussed and theoretical problems related to the formation of solar flares and prominences are studied. (auth)

27793 CONNECTION OF SOURCES OF THE NOISE STORMS WITH THE MAGNETIC FLUX OF SPOTS. Eliseeva, L. A.; Yurovskaya, L. I. Izv. Krym. Astrofiz. Observ.; 49: 42-45 (1974). (In Russian).

From the comparison of the magnetic flux of spots during their passage across the solar disk with emission of noise storm was shown that source of radioemission in the corona is appearing in the interval of rise of magnetic flux at photosphere. Maximum of radioemission and of magnetic flux coincide with accuracy of the order of ±1 day. Very important sources of noise storms were found above young spots. (auth)

27794 OBSERVATIONS OF THE SOLAR ECLIPSE ON FEBRUARY 25, 1971 IN CRIMEA AT THE WAVELENGTH 10 CM. Yurovskii, Yu. F. Izv. Krym. Astrofiz. Observ.; 49: 46-50 (1974). (In Russian).

The analysis of the observational data received during partial eclipse with maximum phase 0.197 has shown, that the distribution of the radiobrightness on the limb of the quiet Solar disk at latitude 70° has a slight maximum at the distance near $20 \cdot 10^3$ km from visible Solar limb. The brightness of the maximum is 20-30% above brightness of the quiet Solar surface. At the day of eclipse some local source existed on the solar disk near the region preliminary taken up by sunspots. Its size was 30-40" and the brightness temperature was of order of $1.2 \cdot 10^6$ °K. (auth)

27795 INHOMOGENEITY OF MAGNETIC FIELD IN THE SUNSPOT UMBRAE. Guseinov, M. D. Izv. Krym. Astrofiz. Observ.; 49: 15-24(1974). (In Russian).

The magnetic field intensities in a few sunspots were measured from 78 polarization spectrograms obtained with the Solar Tower Telescope of the Crimean Astrophysical Observatory in 1957, July 1-15. The magnetic splittings were determined for the following spectral lines: Fe I λ6302,5 Å, V I λ6285,2 Å, V I λ6296,5 Å, Sc I λ6306,0 Å and Ti I λ6312,2 Å. The magnetic field in the dark small scall regions (knots) of umbrae was found to be greater by 200 to 300 gs than the field in the continuous umbral background. It is concluded that the field in the umbra is not homogeneous and apparently consists of three principal components: (a) the bright umbral granules associated with a comparatively small field; (b) the continuous background with moderate field and (c) the dark umbral knots displaying strongest field. (auth)

27796 DETERMINATION OF THE TEMPERATURE AND DENSITY IN THE SUNSPOT AND IN THE CHROMOSPHERE ABOVE THE SUNSPOT. Baranovskii, E. A. Izv. Krym. Astrofiz. Observ.; 49: 25-30(1974). (In Russian).

For the determination of the temperature and density the observed and calculated profiles of the lines H_α and K Ca II are compared. The observed height of the layer above the sunspot where the H_α core originates is also taken into account. The line source function is found by means of solving the combined equations of statistical equilibrium and radiative transfer. The density in the sunspot and the chromosphere above the sunspot is found to be 30 times less as compared to the undisturbed regions. (auth)

27797 NORTH-SOUTH ASYMMETRY IN SOLAR ACTIVITY DISTRIBUTION AND SOLAR-WIND'S STRUCTURE IN MERIDIONAL PLANE OF THE SUN. Vladimirskii, B. M.; Levitskii, L. S. Izv. Krym. Astrofiz. Observ.; 49: 31-35(1974). (In Russian).

The zone of the avoidance in propagation solar protons was located at solar equatorial plane for years 1938-1963 data. It was shown that this avoidance zone for years 1964-1969 was situated at heliolatitudes −2° to −5°. The displacement of the zone to the south may be caused by very large asymmetry in distribution of the solar activity in northern and southern hemispheres for this time. (auth)

27798 MATRIX ANALYSIS OF SOLAR-TERRESTRIAL RELATIONS. Velinov, P. I. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 4, 483-486(1974).

The general and total effect of all elements of solar activity on the course of a number of geophysical and biological processes in the solar-terrestrial space is examined. Also the elements are defined from a single viewpoint by means of the normal course of solar activity. (JFP)

27799 LOW ENERGY SOLAR COSMIC RAYS AND THE CHROMOSPHERIC FLARES. Levitskii, L. S. Izv. Krym. Astrofiz. Observ.; 49: 36-41(1974). (In Russian).

The frequency distribution of the amplitudes of the PCA events is obtained for the years 1965-1969 (new solar cycle). This distribution is the same as at solar cycle No. 19 (1957-1964). A connection between solar proton's flux and the importance of the solar flare was studied. The solar proton's flux are increasing when flares importance is more, this connection is not so clear as the connection between proton's flux and radio burst's energy λλ 3 to 10 cm. It was concluded that the generation of solar cosmic rays with energy ≥ 10 MeV takes place for all the flares with the importance ≥ 1. There are no physical differences between proton and non-proton flares. The longitudinal distribution proton flares and large radio bursts λ 3 to 10 cm was investigated for the new solar cycle. It was shown that the most active longitude's region was situated at 120-300°. It was not active at cycle No. 19. (auth)

27800 OUTLINE OF A THEORY OF SOLAR WIND INTERACTION WITH THE MAGNETOSPHERE. Cole, K. D. (La Trobe Univ., Bundoora, Australia). Planet. Space Sci.; 22: No. 7, 1075-1088(Jul 1974).

From 2nd general scientific assembly of IAGA; Kyoto, Japan (Sep 1973).

Some new ideas on the interaction of the solar wind with the magnetosphere are brought forward. The mechanism of reflection of charged particles at the magnetopause is examined. It is shown that in general the reflection is not specular but that a component of momentum of the particle parallel to the magnetopause changes. A critical angle is derived such that particles whose trajectories make an angle less than it with the magnetopause enter the magnetosphere freely, so transferring their forward momentum to it. Spatially or temporally non-uniform entry of charged particles into the magnetosphere causes electric fields parallel to the magnetopause which either allow the free passage of solar wind across it or vacuum reconnection to the interplanetary magnetic field depending on the direction of the latter. These electric fields can be discharged in the ionosphere and so account qualitatively for the dayside agitation of the geomagnetic field observed on the polar caps. The solar wind plasma which enters the magnetosphere creates (1) a dawn-dusk electric field across the tail (2) enough force to account for the geomagnetic tail and (3) enough current during disturbed times to account for the auroral electrojets. The entry of solar wind plasma across the magnetosphere and connection of the geomagnetic to interplanetary field can be assisted by wind generated electric field in the ionosphere transferred by the good conductivity along the geomagnetic field to the magnetopause. This may account for some of the observed correlations between phenomena in the lower atmosphere and a component of magnetic disturbance. (auth)

27801 SOLAR AND LUNAR INFLUENCES ON THE EARTH'S MAGNETIC FIELD AT ISTANBUL. Isikara, A. M. (Inst. of

Geophysics, Istanbul). Istanbul Univ. Fen Fak. Mecm., Seri C; 36: No. 1-4, 117-127(1971).

An attempt is made to determine the lunar and solar magnetic variations for Istanbul between the years 1949 to 1968, and to work out the relationship between the sunspot cycle and the lunar and solar magnetic variations. Meanwhile, dependence of the lunar and solar magnetic variations of the geomagnetic K-index is also discussed in this study. The main conclusions are as follows: The amplitudes of the geomagnetic lunar variations in all three components (H, Z, D) of the Earth's magnetic field are less in the second ten years (1959–1968) than in the first (1949–1958). However, it has not been found any systematic variation for the phases of lunar magnetic variation in three components within the above mentioned period. The amplitude of the lunar magnetic variation in the three components of the Earth's magnetic field—especially, for the D component—seems to vary in parallel with the sunspot number. From the investigation of the sunspot cycle variation of the amplitude of the solar magnetic variation for magnetically moderate, quiet and disturbed days at Istanbul, a fairly good linear relationship has been found for Z and D components of the Earth's magnetic field. In some cases, it is difficult to say that there is any relationship between the sunspot number and the amplitude of the H component. The remarkable relation between the geomagnetic K-index and the amplitudes of the lunar and solar magnetic variations has also been found. (auth)

27802 SUNSPOT OBSERVATIONS MADE IN 1971. Karaali, S. (Istanbul Univ. Observatory). Istanbul Univ. Fen Fak. Mecm., Seri C; 36: No. 1-4, 129-140(1971).

In the photospheric observations made at the Istanbul University Observatory, observable sunspots and faculae are drawn on a projected disk of the sun and the heliographic coordinates of the sunspots are determined from these drawings. The heliographic coordinates for the sunspot groups observed in 1971 and some other results are given. (auth)

27803 NEUTRINO ENERGY LOSS AND THE SOLAR-NEUTRINO EXPERIMENT. Ruderfer, M. (Dimensions Inc., Hempstead, NY). Lett. Nuovo Cim.; 10: No. 9, 393-398(29 Jun 1974).

Possible neutrino energy loss mechanisms to explain the low yield in the Davis solar-neutrino experiment are examined. The cross section for neutrino-electron Compton scattering (hard scattering) is calculated for ^8B neutrinos in the Sun. The hard scattering effects are further investigated by exploring the astrophysical consequences and comparing them with observation. (LBS)

27804 PROPERTIES OF THE MAGNETIC FIELD EVOLUTION IN A QUIET REGION OF THE SUN. Gopasyuk, S. I.; Tasp, T. T. Izv. Krym. Astrofiz. Observ.; 49: 3-14(1974). (In Russian).

It is found that the number of magnetic hills decreases exponentially with the magnetic peak field strength. Magnetic hill area increases with the increasing peak field strength. The distribution of a magnetic field within a magnetic hill is similar for different dimensions. The magnetic hills which belong to the same chromospheric cell can increase, decay or be stable. The change of the magnetic field of the magnetic hills is not followed by the change of the magnetic field outside the magnetic hills. The birth and fast growth of a magnetic hill of one polarity in the previous region occupied by opposite polarity can be observed sometimes. The observational properties of the magnetic field variation could be explained by rising of the field to the surface of the Sun and descending off this level. (auth)

27805 PHYSICAL PROPERTIES OF SOLAR PLAGES. Shine, R. A. Boulder, CO; Univ. of Colorado (1973). 444p. University Microfilms Order No. 74-12,406.

Thesis (Ph. D.).

The question of how the physical conditions in solar plages differ from the quiet solar atmosphere is investigated with an emphasis on interpreting the Ca II lines at 3934 Å, 3968 Å, 8498 Å, 8542 Å, and 8662 Å. Observations of these lines in a number of solar plages of different degrees of activity, quiet regions, and a sunspot were made. These were done photoelectrically in a double pass mode and particular attention was paid to calibrating the H and K intensities. Although these measurements averaged over a significant portion of a plage (20″) and over time, they are quite suitable for analysis in terms of a plane parallel atmosphere. These observations together with other information available on plages were then used to construct models of both the photospheric and chromospheric regions of plages. A simple direct analysis was developed for the former using the extensive damping wings of these lines. For the chromospheric regions the complications introduced by departures from LTE necessitated a model synthesis approach. Using methods similar to those applied in studies of the quiet chromosphere, we find that the Ca II plage profiles can be qualitatively understood and reproduced with a steeper temperature gradient and the accompanying higher electron densities. Quantitative agreement can be obtained if a macro-velocity field is postulated in addition to the usual micro-velocity field. A grid of models covering the range of activity shown in our observations is given. Computations of the Lyman continuum, the Mg II h and k lines, and the mm continuum are also presented. A preliminary investigation is also made of non-thermal velocity fields without some of the usual assumptions. Non-Gaussian distributions and geometric scales between the microscopic and macroscopic limits are considered. It is found that the latter type of motion can have very significant effects on non-LTE line formation. (Diss. Abstr. Int., B)

27806 EVOLUTION OF SOLAR ACTIVE REGIONS. Moses, R. N. Jr. Columbus, OH; Ohio State Univ. (1974). 171p. University Microfilms Order No. 74-17,795.

Thesis (Ph. D.).

The evolution of solar active regions results from the motions of magnetic field elements. The motion of these field elements is treated using an analogy with the behavior of a two-dimensional compressible gas (shallow water theory). The evolution of an active region is analogous to the creation of two moving sources during the arch filament system (AFS) phase and the flow of field elements from these sources, leading to disturbances which steepen into shock-like features. Two kinds of shocks exist: those within unipolar regions (moats) and those between unipolar regions of opposite polarity (prominences). Some observations associated with the evolution of active regions were: flares and sudden disappearances of prominences are often induced by a disturbance propagating from AFS at about one km/sec; supergranule cell lifetimes rise in active regions; and prominences are more probable on the upstream side of unipolar regions as measured by the relative motion of spots and the photospheric differential rotation. These observations were consistent with the model. (Diss. Abstr. Int., B)

27807 RECENT SOLAR ACTIVITY. Sky Telesc.; 48: No. 3, 160-162(Sep 1974).

Recent solar activity during June and July is described including sunspots, flares, and a light bridge. Increased auroral activity was also noted following a white-light flare. (JFP)

27808 INTERACTION OF THE SOLAR WIND WITH THE LUNAR LIMB. Perez-de-Tejada, H. (Universidad Nacional Autonoma de Mexico, Mexico City). J. Geophys. Res.; 79: No. 13, 1813-1818(1 May 1974).

The viscothermal interaction between a collision-dominated magneto-gas-dynamic flow and a flat solid surface in the presence of a magnetic field aligned to the flow direction is examined under conditions representing those of the solar wind at the lunar limb. Within the context of this continuum fluid approach it is possible to predict the generation of positive magnetic field perturbations at the lunar limb with magnitudes comparable to those of the observed magnetic penumbral increases of the moon's wake. An analytical expression for the normalized magnitude of the magnetic field intensity at the surface is derived and computed for different boundary conditions imposed on the surface. The functional dependence exhibited by this expression on the ratio of the magnetic to the thermal pressure of the incident flow for cases in which its temperature is larger than the surface temperature is compatible with that inferred from observational studies of the intensity of magnetic penumbral increases of the moon's wake. A discussion of the effects that the presence of a shock front placed ahead of the lunar terminator produces on the viscothermal interaction at the lunar limb is also included. It is suggested that the magnetic field perturbations generated within the boundary layer at the limb are enhanced by the thermalization of the solar wind across the shock. (auth)

27809 UPPER LIMITS FOR THE SOLAR WIND He^+ CONTENT AT 1 AU. Feldman, W. C. (Los Alamos Scientific Lab., NM); Asbridge, J. R.; Bame, S. J.; Kearney, P. D. J. Geophys. Res.; 79: No. 13, 1808-1812(1 May 1974).

An upper limit for the steady state solar wind He^+ concentration is estimated from four Vela 5 and 6 heavy ion spectrums. The upper limit value for $N(He^+)/N(H)$ of 2.5×10^{-6} so obtained is at least an order of magnitude less than that predicted from presently accepted models of the local interstellar medium. The most likely explanation of the discrepancy is that wave-particle interactions are not capable of fully assimilating the initially non-Maxwellian high-temperature He^+ particles of interstellar origin into the solar wind flow. Occasional flow conditions resulting in complete assimilation cannot be ruled out. (auth)

27810 ASYMMETRIES OF THE SOLAR Ca II LINES. Heasley, J. N. New Haven; Yale Univ. (1973). 159p. University Microfilms Order No. 74-13,045.

Thesis (Ph. D.).

A theoretical study of the influence of propagating acoustic pulses in the solar chromosphere upon the line profiles of the Ca II resonance and infrared triplet lines has been made. The major objective has been to explain the observed asymmetries of the core emissions seen in the Ca II H and K lines and to predict the temporal behavior of the infrared lines caused by the acoustic or shock pulses. The non-LTE line formation problem has been solved using a new version of the complete linearization technique. The new method has the same asymptotic timing and storage requirements as integral equation schemes but does not suffer the self-consistency problems the latter techniques sometimes encounter when problems involving several interlocking radiative transitions are treated. The velocities in the pulses, calculated from weak shock theory, have been included consistently in the non-LTE calculations. The results of our calculations show that the lines are very sensitive to the perturbations in the background atmosphere caused by the pulses. Only minor changes in the line shapes result from including the velocities consistently in the source function calculations. The qualitative changes in the line profiles vary markedly with the strength of the shock pulses. The observed differences in the K line profiles seen on the quiet sun can be explained in terms of a spectrum of pulses with different wavelengths and initial amplitudes in the photosphere. (Diss. Abstr. Int., B)

27811 DETERMINATION OF HEATING TIME IN UPPER LAYERS OF CHROMOSPHERE. Livshits, M.A.; Badalyan, O.G. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation, Academy of Sciences of the USSR). Sov. Astron.-AJ 18: No. 1, 81-86 (July 1974).

The propagation of heat is examined in a column of gas with boundary temperatures of 10^6 and 10^4 °K and with hydrostatically varying density, independent of time. Numerical calculations were made on an electronic computer by the method of finite differences. It is found that at a level with $n \simeq 3 \cdot 10^{10}$ cm^{-3} a temperature of 10^5 °K is reached only 6 min after the process begins. Then the time variation in density is taken into account by a joint solution of the equations of thermal conduction and hydrostatic equilibrium and it is shown that some increase in density at the top of the column caused by "evaporation" does not significantly influence the initial phases of the propagation of a thermal disturbance. In addition, an estimate of the mass of gas escaping from the chromosphere into the corona is formally obtained. (auth)

27812 POSSIBLE FORMATION MECHANISM FOR SOLAR SURGES AND SPRAYS. Lyong, L.V. (Shternberg Astronomical Institute, Moscow, North Vietnam Meteorological Service). Sov. Astron.-AJ 18: No. 1, 87-93 (July 1974).

Surges originate in the lower chromosphere, with dark surges being formed where the magnetic field has a well configuration. The energy of the parent flare is injected along the field lines and distends the magnetic arches that support the chromospheric material in the well. As a result the well material rises and is stretched out. The combined action of magnetic tension and gravity produces an oscillatory motion. Bright surges are gas condensations formed in flares; magnetic tension raises and stretches them. In this situation the lines of force are reconnected in a vertical plane. Calculations of the motion yield good agreement with observational evidence. Three factors might cause the curvature of surge trajectories: asymmetric energy injection, instability of the magnetic well against horizontal disturbances, and nonidentical field reclosure. Both shock waves and cosmic rays could serve to distend the magnetic arches. The computed surge oscillation period and radius agree with observations. The energy balance of a surge is discussed briefly. Surges are heated by a flux of magnetoacoustic waves from below. The wave flux escaping from the top of a surge into the corona is strong enough to produce a temperature irregularity there. Spray prominences are formed in the same manner as bright surges, but the field reclosure takes place in the middle chromosphere. Again the computed motion agrees satisfactorily with observation. (auth)

27813 POLARIZATION OF THE SOLAR CORONA ON SEPTEMBER 22, 1968. Lipskii, Y.N.; Bugaevskii, A.V.; Pskovskii, Y.P. (P. K. Shternberg State Astronomical Institute). Sov. Astron.-AJ 18: No. 1, 94-98 (July 1974).

During the total solar eclipse of September 22, 1968, 12 photographs of the solar corona were obtained near Sary-Shagan using an aerial camera with polaroid filters. The use of a specially prepared pyramid with polaroids which was mounted in front of the objective made it possible to obtain three polarized images in one exposure. An analysis of the four best photographs on an MF-6 microphotometer with calculations on an M-20 electronic computer gave the degree of polarization and the orientation of the polarization planes in the corona at distances of 1.20-1.25 $R_\odot$ from the limb. The precision in determining the polarization parameters was 3-4%. The mean polarization over all position angles for the given distances from the limb differs little from the theoretical value. A marked decrease in the degree of polarization is observed at prominences and at a flare. The local plane of polarization is radially oriented on the average, while it differs from this direction near prominences. (auth)

27814 PARAMETRIC WAVE INTERACTION IN A MAGNETIZED PLASMA. Schanda, E. (Univ., Bern). pp 291-298 of Summer School on Plasma Physics and Solar Radioastronomy. Vol. 1. Mangeney, A. (ed.). Meudon, France; Observatoire de Paris-Meudon (1973).

From proceedings of the summer school on plasma physics and solar radioastronomy; Ile de Re, France (4 Sep 1972).

The nonlinear coupling of radiowaves is an important process in stellar atmosphere during the release of flares. This type of coupling is studied. (auth)

27815 ASPECTS OF CORONAL STRUCTURES. Heyvaerts, J. (Observatoire de Paris); Pick, M. pp 118-175 of Summer School on Plasma Physics and Solar Radioastronomy. Vol. 1. Mangeney, A. (ed.). Meudon, France; Observatoire de Paris-Meudon (1973).

From proceedings of the summer school on plasma physics and solar radioastronomy; Ile de Re, France (4 Sep 1972).

The following topics are treated: structure of the solar corona (coronal condensations, coronal enhancements, streamers), type III bursts, theoretical models for streamers, and the magnetic structure of the corona. (auth)

27816 SHOCK WAVES AND RELATED RADIOBURSTS. Boischot, A.; Mangeney, A. (Observatoire de Paris). pp 176-232 of Summer School on Plasma Physics and Solar Radioastronomy. Vol. 1. Mangeney, A. (ed.). Meudon, France; Observatoire de Paris-Meudon (1973).

From proceedings of the summer school on plasma physics and solar radioastronomy; Ile de Re, France (4 Sep 1972).

The characteristics of type II and type IV radiobursts are recalled. Emission mechanisms, dynamic spectra, and source shape and position are studied. These bursts are due to disturbances produced by flares, these disturbances propagating upwards through the corona. The origin and nature of these disturbances are discussed. The mechanisms responsible for the production of the plasma waves involved in type II bursts are analyzed, together with the acceleration or trapping of relativistic electrons in type IV bursts. (auth)

27817 PERIODICITIES IN SOLAR RADIO EMISSION. Abrami, A. (Trieste Astronomical Observatory, Italy). pp 233-244 of Summer School on Plasma Physics and Solar Radioastronomy. Vol. 1. Mangeney, A. (ed.). Meudon, France; Observatoire de Paris-Meudon (1973).

From proceedings of the summer school on plasma physics and solar radioastronomy; Ile de Re, France (4 Sep 1972).

Periodic or nearly periodic phenomena observed in the meter and decimeter band during emission enhancements correlated with solar flares are described; perturbations travelling across the solar atmosphere are discussed. (auth)

27818 FINE STRUCTURE IN SPECTRA OF SOLAR RADIO BURSTS. Slottje, C. (Netherlands Foundation for Radio Astronomy, Dwingeloo). pp 245-259 of Summer School on Plasma Physics and Solar Radioastronomy. Vol. 1. Mangeney, A. (ed.). Meudon, France; Observatoire de Paris-Meudon (1973).

From proceedings of the summer school on plasma physics and solar radioastronomy; Ile de Re, France (4 Sep 1972).

Fine structures appearing in type II and type IV burst spectra are described. (auth)

27819 FINE STRUCTURE BURST AT METRE AND DECAMETRE WAVELENGTHS. de La Noe, J. (Observatoire de Paris). pp 260-271 of Summer School on Plasma Physics and Solar Radioastronomy. Vol. 1. Mangeney, A. (ed.). Meudon, France; Observatoire de Paris-Meudon (1973).

From proceedings of the summer school on plasma physics and solar radioastronomy; Ile de Re, France (4 Sep 1972).

Spectral characteristics of stria bursts, split pair bursts and triple bursts are presented. Up to now, these bursts have not been explained. (auth)

27820 INTENSITY DECREASE OF MICROWAVE BURSTS CORRELATED WITH TYPE II METER EMISSION. Fuerst, E. (Max-Planck-Institut fuer Radioastromie, Bonn). pp 272-287 of Summer School on Plasma Physics and Solar Radioastronomy. Vol. 1. Mangeney, A. (ed.). Meudon, France; Observatoire de Paris-Meudon (1973).

From proceedings of the summer school on plasma physics and solar radioastronomy; Ile de Re, France (4 Sep 1972).

The emission process of microwave bursts correlated with type II meter wavelength emission is recalled. The source model presented is shown to explain the intensity decrease of bursts, caused by heat conduction along the magnetic field. (auth)

27821 EVIDENCE FOR NONLINEAR EFFECTS IN SOLAR METRIC RADIATION. Chiuderi, C. (Osservatorio Astrofisico di Arcetri, Florence, Italy). pp 288-290 of Summer School on Plasma Physics and Solar Radioastronomy. Vol. 1. Mangeney, A. (ed.). Meudon, France; Observatoire de Paris-Meudon (1973).

From proceedings of the summer school on plasma physics and solar radioastronomy Ile de Re, France (4 Sep 1972).

A series of drifting parallel bands, having a periodic structure in frequency was observed recently in metric radioemission solar spectra. It is shown that nonlinear processes are involved in the interpretation of this phenomenon. (auth)

27822 SOLAR WIND ELECTRON TEMPERATURE DEPRESSIONS FOLLOWING SOME INTERPLANETARY SHOCK WAVES: EVIDENCE OF MAGNETIC MERGING?. Montgomery, M.D.; Asbridge, J.R.; Bame, S.J.; Feldman, W.C. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). J. Geophys. Res. 79: No. 22, 3103-3110 (1 Aug 1974).

An investigation of periods of anomalously low solar wind electron temperatures using 14 months of Vela 5, Vela 6, and Imp 6 measurements has shown a very strong tendency for unusually low temperatures to follow interplanetary shock waves by 10–20 hours. Of 12 low-temperature regions observed, 10 occurred in direct association with a well-defined shock-associated ssc. A detailed investigation of these events has shown that (1) the periods persist for 10 to >40 hours; (2) a distinct depression in proton temperature occurs simultaneously: (3) the electron heat flux tends to be significantly reduced, but the velocity distributions are less Maxwellian: (4) for one event the He/H concentration is found to rise significantly at about the time of the initial decrease in temperature: for most of the events the data are not continuous enough to check this association: and (5) about half of the observed shocks were followed by temperature depressions. The existence of regions with abnormally low electron temperatures is consistent with the formation of closed or nearly closed magnetic field configurations that more or less thermally isolate the electrons from the relatively hot corona. The electron component of the plasma within these regions thus cools in relation to plasma electrons embedded in open field regions as the closed or constricted regions expand away from the sun. (auth)

27823 SEARCH FOR THE SOLAR WIND IN THE LUNAR SOIL. Payton, P. H. Los Angeles; Univ. of California (1974). 159p. University Microfilms Order No. 74-18,799.

Thesis (Ph. D.).

Calculations are presented for the contribution of the solar wind to the elemental abundances in the surface layer of the lunar soil particles. Some theoretical aspects of the solar wind interaction with the lunar surface are considered. Results are presented from the analysis of lunar soil utilizing the trace analytical techniques of cyclotron-produced high energy proton induced x-ray emission spectroscopy, high energy photon activation analysis, and flameless atomic absorption spectroscopy. (Diss. Abstr. Int., B)

27824 SOLAR-FLARE EMISSION LINES IN THE RANGE FROM 66 TO 171 Å; $2s^22p^k-2s^{-1}2p^{k+1}$ TRANSITIONS IN HIGHLY IONIZED IRON. Kastner, S.O.; Neupert, W.M.; Swartz, M. (Solar Plasmas Branch, Laboratory for Solar Physics, NASA-Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. 191: No. 1, 261-270 (1 July 1974).

New emission lines found in several flare spectra obtained with the Goddard grating spectrometer on the OSO-5 satellite, in 1969, have been listed by wavelength and relative intensity. These new lines, including several as strong as normal quiet-Sun lines, are extremely variable in intensity and have been assigned mainly to transitions of the type $2s^22p^k-2s^{-1}2p^{k+1}$ in iron ions up to Fe XXIII. (auth)

27825 THE DYNAMICAL PROPERTIES OF TWISTED ROPES OF MAGNETIC FIELD AND THE VIGOR OF NEW ACTIVE REGIONS ON THE SUN. Parker, E.N. (Department of Physics and Department of Astronomy and Astrophysics, University of Chicago, Chicago, Illinois 60637). Astrophys. J. 191: No. 1, 245-254 (1 July 1974).

The equilibrium configuration following expansion of all, or part, of a force-free magnetic rope is worked out formally from the hydromagnetic equilibrium equations. It is shown that expansion of a portion of the length of a long magnetic rope beyond a certain radius causes the expanded portion to be wrapped with an azimuthal field composed of lines of force from the surface layer of the unexpanded portion. This singular redistribution takes an extended period of time to achieve. Further, it automatically causes the expanded portion to become unstable to buckling. We suggest that the restless behavior of the magnetic fields in new active regions in the solar photosphere is largely a result (a) of the buckling brought about by the expansion of the fields as they emerge through the photosphere, and (b) of the long-term redistribution of the surface lines of force onto the expanded portion of the rope. (auth)

27826 RESEARCH WITH SOLAR SATELLITES. Goldberg, L. (Kitt Peak National Observatory). Astrophys. J. 191: No. 1, 1-37 (1 July 1974).

The accomplishments and results of research with the unmanned Orbiting Solar Observatories and the manned Apollo Telescope Mount are discussed. Various models of the sun are examined. (AIP)

27827 FILAMENTARY STRUCTURE OF THE SUNSPOT MAGNETIC FIELDS. Pratap, R. (Indian Inst. of Geomagnetism, Bombay). Pramana; 2: No. 6, 327-335(Jun 1974).

The filamentary structure of the magnetic fields as well as the coherent radiations that emanate from a sunspot are explained considering solar burst as a nonequilibrium process. Methods of irreversible statistical mechanics were applied to the problem of an electron gas in a constant magnetic field to explain the above features. The nonequilibrium distribution function was obtained in the self-consistent field approximation. The dielectric function obtained is a function of time, besides being a function of frequency and wave vector. Thus the nonlinearity of the system was taken into account as well. This theory explains many features of stria bursts, chain bursts as well as the type III bursts. This also accounts for the bunching of the magnetic field lines as a consequence of quantization of flux in the Landau sense. (auth)

27828 ONE- AND MULTI-COMPONENT MODELS OF THE UPPER PHOTOSPHERE BASED ON MOLECULAR SPECTRA. II. CN(1,1) of the CN Violet System. Mount, G. H.; Linsky, J. L. (National Bureau of Standards, Boulder, Colo. (USA)). Solar Phys.; 35: No. 2, 259-276(Apr 1974).

Center-to-limb photoelectric spectra have been obtained of the CN(1,1) B-X band-head region λ3868-3872 Å at Kitt Peak National Observatory. From these spectra and a detailed analysis of the formation of the CN(1,1) spectrum, a best-fit upper photospheric model is derived which differs from the HSRA, which is consistent with previous CN(0,0) λ3883 spectra. A solar carbon abundance of log Ac = 8.30 ± 0.10 is derived; this is to be compared to the HSRA value of log Ac = 8.55 ± 0.10. In addition, the authors specify the regions of formation for the CN(0,0) λ3883.35 and CN(1,1) λ3871.38 bandheads at disc center and limb. (11 figures, 5 tables) (auth)

27829 TEMPERATURE VARIATIONS IN THE SOLAR PHOTOSPHERE. II. A Search for Equator-to-Pole Differences in Photospheric Temperature. Falciani, R.; Rigutti, M.; Roberti, G. (Capodimonte Astronomical Observatory, Naples, Italy). Solar Phys.; 35: No. 2, 277-280(Apr 1974).

From the variations in equivalent width of a selected set of Fraunhofer lines, the variation of effective temperature and microturbulence velocity between the equator and the regions at heliographic latitude of ≈ 72° is derived. The reliability of the results ($\Delta T/T = 0 \pm 0.6\%$, $\Delta\xi/\xi = 6\% \pm 13\%$) needs further investigation, but from the analysis of the data it can be stated that temperature variations, if any, are very small. Some suggestions for more fruitful measurements are also given. (1 table) (auth)

27830 THE SOLAR ABUNDANCE OF GERMANIUM. Ross, J. E.; Aller, L. H. (California Univ., Los Angeles (USA)). Solar Phys.; 35: No. 2, 281-286(Apr 1974).

The solar abundance of germanium, deduced from two relatively unblended Ge I lines, λ3039.06 and λ3269.50, is found to be log N(Ge) = 3.50 ± 0.05 on the scale log N(H) = 12.00, in good agreement with Cameron's recent solar system abundance log N(Ge) = 3.56 (on assumption log N(Si) = 7.50). (13 figures, 4 tables) (auth)

27831 ON THE STRUCTURE AND MOTION OF A SPICULE. Unno, W. (Tokyo Univ. (Japan)); Ribes, E. (Observatoire de Paris, Section de Meudon, 92 (France). Section d'Astrophysique); Appenzeller, I. (Goettingen Univ. (F. R. Germany)). Solar Phys.; 35: No. 2, 287-308(Apr 1974).

A stationary, two-dimensional, isothermal flow parallel to the magnetic lines of force is studied in connection with the hydrodynamic support of a spicule. Observed large extension into the corona (~6000 km) and high velocities (~25 km s^{-1}) can be explained consistently if the effective kinetic temperature within a spicule could be about 10^4 K in the chromospheric region ($z < 2000$ km) and increase to about 2.5×10^4 K or more in the coronal region ($z > 2000$ km). In a special simple case, an analytic solution of equations of motion is obtained and is used for explaining why the pressure in a spicule can be higher than the normal surrounding pressure in upper levels. Comparison between the effective kinetic temperatures for the spicule support and the

empirical electron temperatures shows that they are about the same in lower levels (z < 2000 km) but contributions to the effective kinetic temperature other than the electron temperatures are necessary in higher levels (z > 2000 km). Thus, the authors postulate the role of acoustic waves that are enhanced by the presence of the magnetic field and are practically undamped in the accelerated flow in a spicule. The coupling between the acoustic waves and the outward expanding motion initiated at the foot of a spicule by the magnetic buoyancy and the solar oscillation is thought to be similar to the mechanism of a geyser, in which the bubble formation in an ascending flow is fundamental. The magnetic field strength adequate to provide an appropriate circumstance for the occurrence of a spicule is considered to be about 200 G at the base of the chromosphere. Observational implications are briefly discussed. (4 figures) (auth)

27832 TEMPORAL VARIATIONS OF THE MAGNETIC FIELD IN SUNSPOTS. Schultz, R. B.; White, O. R. (National Center for Atmospheric Research, Boulder, Colo. (USA)). Solar Phys.; 35: No. 2, 309-316(Apr 1974).

Simultaneous spectra were obtained with a spatial resolution of ½" and a temporal resolution of 15 s in Hα, Ca II-K, Ca II 8542 Å, and three Fe I lines of the sunspot group responsible for the large flares of August, 1972 (McMath No. 11976). A time series taken 1972, August 3 in the Fe I 6173 Å Zeeman sensitive line was analyzed for oscillations of field strength and the angle between the field and the line of sight, and for changes of the field associated with the Ca II-K umbral flashes discovered by Beckers and Tallant (1969). The power spectra show no significant peaks, conflicting with the results of Mogilevskii et al. (1972), who reported oscillations in the longitudinal component of the field strength with periods of 56, 90, and 150 s. Changes in the field were not observed to be correlated with the occurrence of umbral flashes. These results place restrictions on magnetic modes of energy transport between the photospheric layers and the chromospheric layers where the umbral flashes are observed. (5 figures, 1 table) (auth)

27833 UMBRAL INTENSITIES OF LARGE SUNSPOTS. Ekmann, G.; Maltby, P. (Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk). Solar Phys.; 35: No. 2, 317-322(Apr 1974).

Observations of the intensities of sunspot umbrae at the Oslo Solar Observatory during 5 yr are described. From the observational material measurements have been selected where the corrections for scattered light are small. The results for 5 large sunspots observed in 6 (alternatively 7) wavelength regions are presented. The observations show that possible intensity differences between individual sunspots are difficult to detect in the visible part of the spectrum. Real differences between individual sunspots are detected in the infrared region. (3 tables) (auth)

27834 COMMENTS ON WILSON'S MODEL OF COOLING OF A SUNSPOT. Research Note. Gokhale, M. H. (Physical Research Lab., Ahmedabad (India)). Solar Phys.; 35: No. 2, 323-324(Apr 1974).

Wilson (1972) has suggested the interesting possibility that sunspots may be cooled by a refrigeration cycle run by the magnetic fields. The fluid motion in the phase AB of his refrigeration cycle is similar to the motion of magnetic "knots" observed by Sheeley and Vrabec. In this note reasons why the "model" on the basis of which he identifies the two motions is not acceptable are outlined. (NL)

27835 SHORT PERIOD VARIATION OF THE PHOTOSPHERIC MAGNETIC FIELD. Csada, I. K. (Konkoly Observatory, Budapest, Hungary). Solar Phys.; 35: No. 2, 325-330(Apr 1974).

The photospheric magnetic data recorded from August 12, 1959, to September 29, 1967, and averaged over Bartels rotation periods are treated as zonal terms of the solar magnetic field, which is expanded in a series of spherical harmonics. Numerical analysis of the reduced data gives seven periods. Three of these seem to be essential in the superposed variation of the solar magnetic field. The first of them (17.74 yr) is thought to be a contribution from the magnetic cycle for the determination of which the data covering only 8 yr interval are of insufficient accuracy. For this reason, a 22.2 yr period is favored by the computations. The numerical values of the two shorter periods are deduced as 2.557 yr and 4.194 yr. The amplitudes and phase angles of the periodic terms in question are determined. (2 figures, 5 tables) (auth)

27836 A SEARCH FOR THE FOOTPOINTS OF SOLAR MAGNETIC FIELDS. Simon, G. W.; Zirker, J. B. (Sacramento Peak Observatory, Sunspot, N. M., USA). Solar Phys.; 35: No. 2, 331-342(Apr 1974).

High-resolution measurements of magnetic fields have been made in quiet and active regions in order to determine whether the photospheric fine-structures ("crinkles"), recently photographed by Dunn (1972), coincide with the footpoints of strong, compact fields. Magnetic fields ranging up to 1400 G have been measured in small structures that lie at the centers of spicule bushes or within a plage. However, the diameters of the flux tubes, at the height where FeI 6302.5 forms, are typically 1" to 2", compared with crinkle dimensions of 0.25" × 1". This discrepancy cannot be explained by a sharp height variation of the flux tube cross section. By comparing the results with Dunn's photographs, it is concluded that, although crinkles appear to lie at or near the strongest field intensities, photospheric magnetic flux is not confined solely within the area of the crinkles, but may extend over a larger area defined by the "abnormal" granulation. (5 figures, 2 tables) (auth)

27837 ON POLARIMETRY IN SOLAR ACTIVE REGIONS. VII. A New Zeeman Polarimeter and Its Advantages as Compared to Other Designs. Wiehr, E. (Goettingen Univ. (F. R. Germany)). Solar Phys.; 35: No. 2, 351-359(Apr 1974).

A new modulation procedure for Zeeman polarimeters is described and tested. The azimuth rotation by means of two steady λ/4 plates, combined with the common EOLM, has several advantages as compared to "two-EOLM polarimeters." The new polarimeter operates with two λ/4 plates, which are alternately passed through the beam in front of the EOLM by means of an electromechanical chopper. The exact time of the λ/4 plate change is monitored by a photoelectric sensor. The signals obtained drive a number of relays by use of an intervening bistable electronic device. These relays allow cut-off of the erroneous Doppler signal mode, and furthermore they distribute the U and Q signals into the corresponding lock-in amplifiers. As a first application of the new polarimeter, the linear polarization is measured in a sunspot penumbra. The telescope was first compensated for instrumental linear polarization down to $\leq 5 \times 10^{-4}$ by means of a tilted glass plate as well as for phase retardation down to ≤1° by means of a Bowen compensator. (4 figures) (auth)

27838 THE RELATIONSHIP BETWEEN THE SLOWLY VARYING COMPONENT OF SOLAR RADIO EMISSION AND LARGE SCALE PHOTOSPHERIC MAGNETIC FIELD PATTERNS. Scherrer, P. H. (Stanford Univ., Calif. (USA). Inst. for Plasma Research); El-Raey, M. (California Univ., Berkeley (USA). Space Sciences Lab.). Solar Phys.; 35: No. 2, 361-368(Apr 1974).

Daily solar radio flux observations have been examined for a relationship to the large-scale photospheric magnetic field structure. Interplanetary magnetic field sector boundaries were used to indicate boundaries between photospheric field regions of opposite polarity. An enhancement in emission was found about four days before the boundary central meridian passage. Most of the effect came from emission near toward-to-away type boundaries. A higher level of emission appears to be associated with toward field regions than with away field regions. (6 figures) (auth)

27839 PHOTOGRAPHIC PHOTOMETRY OF THE SOLAR CORONA. Observed During the Total Eclipse of 10 July 1972. Koutchmy, S. (Centre National de la Recherche Scientifique, 75-Paris (France). Inst. d'Astrophysique); Dzubenko, N. I.; Nesmjanovich, A. T.; Vsekhsvjatsky, S. K. (Univ. Schevschenko, Kiev, Ukranian SSR). Solar Phys.; 35: No. 2, 369-375(Apr 1974). (In French).

A series of plates of the solar corona were obtained during the total solar eclipse of July 10th, 1972, near Anadyr (U.S.S.R.) by using a standard eclipse coronagraph of $\phi = 20$ cm and $F = 300$ cm. A neutral radial filter was specially conceived to enable the study of the corona up to 5 $R_\odot$ and also of the lunar background. The absolute calibration takes into consideration the different components of the recorded radiation: the K and F corona, the sky background B_c, the coronal aureola B_{aur} and details of the earthshine on the lunar background. The brightness of the corona (K + F) is given along the N-S and E-W axes and also the total brightness recorded along the tangential directions, at selected radial distances. The photometry shows that the K corona in 1972 was very heterogeneous and its mean brightness, close to that of a corona of maximum activity for $r < 2R_\odot$. Moreover, the difference of brightness between the equator and the poles for $r > 2R_\odot$ is about twice larger than in the Van de Hulst' model of the corona of minimum activity. At the north pole, a coronal "hole" clearly appears. (4 figures) (auth)

27840 CURVATURE AND SURFACE DISTRIBUTION OF THE POLAR RAYS IN THE SOLAR CORONA ON 12 NOVEMBER 1966. Kirk, J. G. (Kitt Peak National Observatory, Tucson, Ariz. (USA)); Newby, J. S. (Toledo Univ., Ohio (USA)). Solar Phys.; 35: No. 2, 377-384(Apr 1974).

By following a technique developed by Saito, the positions and orientations of the polar rays visible in a photograph of the total solar eclipse of 12 November 1966 were examined to infer the length of an equivalent bar magnet representing the Sun's external

magnetic field and the true distribution of polar rays from the two-dimensional projection seen in the photograph. In spite of the strong asymmetry in solar activity between the northern and southern solar hemispheres at the time of the eclipse, it was found that the magnetic field as delineated by the polar rays could be well represented by an extended dipole whose poles were each 0.43 $R_\odot$ from the center of the Sun and on the axis of rotation. The polar rays were distributed mainly in a circular zone 9° away from the pole and about 8° wide, with this zone bounded by empty regions at the pole and 15° to 20° away from it, beyond which there were again some rays, but not so many. These results are in good accord with expectation from Saito's analysis. (4 figures, 2 tables) (auth)

27841 ON THE NATURE OF PLASMA ARCS IN SOLAR ACTIVE REGIONS. Gajewski, R. (American Science and Engineering, Inc., Cambridge, Mass.). Solar Phys.; 35: No. 2, 385-394 (Apr 1974).

A mechanism is proposed to explain the structures consisting of plasma arcs observed in x-ray photographs of solar active regions. It is suggested that the width of the arcs corresponds to the cut-off wavelength of a Rayleigh–Taylor instability which develops due to a difference in density between the plasma in the arcs and the plasma in the surrounding region. The transverse component of the magnetic field necessary to stabilize the instability at a wavelength corresponding to the width of the arcs is estimated to be of the order of 0.1 G. (8 figures) (auth)

27842 ON PECULIARITIES OF THE H AND K Ca II LINES OF QUIESCENT PROMINENCES. Morozhenko, N. N. (AN Ukrainskoj SSR, Kiev). Solar Phys.; 35: No. 2, 395-400(Apr 1974).

A study of the metallic lines in bright quiescent prominences indicates that the optical thickness in the K line of Ca II may reach values as high as 10^3. This is about 10 times larger than the optical thickness in the Hα line, and may explain some peculiarities of the H and K lines in solar prominences. (1 figure, 3 tables) (auth)

27843 THE LOOP PROMINENCE OF 11 AUGUST 1972: A CORONAL CONTINUUM EVENT. Fisher, R. R. (Sacramento Peak Observatory, Sunspot, N. M., USA). Solar Phys.; 35: No. 2, 401-408(Apr 1974).

Observations of a loop prominence formed after the flare of 11 August 1972 are discussed. Estimates of electron density are obtained from (a) the line ratio of the Ca XV forbidden lines and (b) a Thompson scattering model. Both methods give an approximate value of $n_e \approx 10^{11}$ cm^{-3}. This density was high enough to render the loop structures visible as continuum features, corresponding to the Ca XV structures as seen in the plane of the sky. By a double exposure technique, it was found that the loop structures seen in Hα and Fe XIV differ significantly. (5 figures) (auth)

27844 AN ERUPTIVE PROMINENCE OF JUNE 10, 1973. Engvold, O.; Rustad, B. M. (Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk). Solar Phys.; 35: No. 2, 409-417(Apr 1974).

An eruptive prominence of June 10, 1973, showing ascending and expanding motions, was recorded spectroscopically at Oslo Solar Observatory. The Ca II H line yielded broadening velocities ranging from 5 km s^{-1} to 20 km s^{-1}. An extreme ratio of $1/_{30}$ was measured for line-broadening to expansion velocity. Flare activity succeeded the start of the observed disparition brusque phase of the prominence. The eruption is related to coronal disturbances recorded approximately 1 hr later by ATM, Skylab. (5 figures, 1 table) (auth)

27845 HARD SOLAR FLARE X-RAY BURSTS ON 8 DECEMBER 1970. Anderson, K. A.; Mahoney, W. A. (California Univ., Berkeley (USA). Dept. of Physics). Solar Phys.; 35: No. 2, 419-430(Apr 1974).

Hard X-ray bursts have been observed from two 1B flares located in the same sunspot region and separated in time by about 70 min on 8 December 1970. The bursts are composed by many "flashes" of 2 to 20 seconds duration. Power spectrum analysis reveals no strong periodicities, although a significant peak appears at 7.5 s. The characteristic times of 2 to 20 s do not seem likely to be electron transit times since the flare size is so small. These times are evidently connected with the acceleration of the electrons. By fitting Takakura's model of the radio noise region to the observations, this region is found to be small; but the density of electrons above 100 keV is high, on the order of 10^7 cm^{-3}. (5 figures, 1 table) (auth)

27846 ON ANISOTROPY OF SOLAR HARD X-RAY EMISSION. Pizzichini, G.; Spizzichino, A.; Vespignani, G. R. (Consiglio Nazionale delle Ricerche, Bologna (Italy)). Solar Phys.; 35: No. 2, 431-439(Apr 1974).

A number of solar X-ray events above 10 keV and 20 keV were compiled in order to test for evidence of anisotropic emission. The results are not definite, although the two samples show apparently different behaviors. (1 figure, 3 tables) (auth)

27847 A RELATIONSHIP BETWEEN THE BRIGHTNESS TEMPERATURES FOR TYPE III BURSTS. Melrose, D. B. (Commonwealth Scientific and Industrial Research Organization, Epping (Australia). Div. of Radiophysics). Solar Phys.; 35: No. 2, 441-450(Apr 1974).

Type III bursts often have brightness temperatures at the fundamental greater than 10^9K. If the fundamental emission is due to scattering of Langmuir waves into transverse waves by thermal ions, then induced scattering dominates over spontaneous scattering, which in turn requires that the energy density in Langmuir waves be greater than some minimum value, e.g. $W! > 3 \times 10^{-10}$ erg cm^{-3} for bursts at $f_p = 100$ MHz. Such Langmuir waves become isotropic on a time-scale shorter than the rise-time of type III bursts, e.g. < 1 s at $f_p = 100$ MHz. Consequently, their coalescence, leading to emission at the second harmonic, proceeds. The above inequalities would imply a brightness temperature at the second harmonic in excess of 10^9K at $f = 200$ MHz. The predicted values of the brightness temperatures T_1^t and T_2^t (at the fundamental and second harmonic, respectively) can be expressed in terms of an optical depth τ. After τ is eliminated, a functional relation between T_1^t, T_2^t, and the plasma frequency, f_p, remains. The form of this relation is not dependent on a quantitative theory of how the Langmuir waves are generated by the stream of electrons. Consequently, comparison with observed quantities should provide further insight into the detailed properties of the emission processes. (2 figures) (auth)

27848 EXCESS HEATING OF CORONA AND CHROMOSPHERE ABOVE MAGNETIC REGIONS BY NON-LINEAR ALFVEN WAVES. Uchida, Y. (Tokyo Univ., Mitaka (Japan). Tokyo Astronomical Observatory); Kaburaki, O. (Tokyo Univ. (Japan)). Solar Phys.; 35: No. 2, 451-466(Apr 1974).

Excess heating of the active region solar atmosphere is interpreted by the decay of MHD slow-mode waves produced in the corona through the nonlinear coupling of Alfven waves supplied from subphotospheric layers. It is stressed that the Alfven-mode waves may be very efficiently generated directly in the convection layer under the photosphere in magnetic regions, and that such magnetic regions, at the same time, provide the "transparent windows" for Alfven waves in regard to the Joule and frictional dissipations in the photospheric and subphotospheric layers. Though the Alfven waves suffer considerable reflection in the chromosphere and in the transition layer, a certain fraction of this large flux is propagated out to the corona, and a large velocity amplitude exceeding the local Alfven velocity is attained during the propagation along the magnetic tubes of force into a region of lower density and weaker magnetic field. The otherwise divergence-free velocity field in Alfven waves gets involved in such a case with a compressional component (slow-mode waves) which again is of considerable velocity amplitude relative to the local acoustic velocity when estimated by using the formulation for nonlinear coupling between MHD wave modes derived by Kaburaki and Uchida (1971). Therefore, the compressional waves thus produced through the nonlinear coupling of Alfven waves will eventually be thermalized to provide a heat source. The introduction of this nonlinear coupling process and the subsequent thermalization of slow-mode waves thus produced may provide means of converting the otherwise dissipation-free Alfven mode energy into heat in the corona. The liberated heat will readily be redistributed by conduction along the magnetic lines of force, with higher density as a consequence of increased scale height, and thus the loop-like structure of the coronal condensations (or probably also the thread-like feature of the general corona) may be explained in a natural fashion. (5 figures) (auth)

27849 HEATED SOLAR ATMOSPHERE: A ONE-FLUID MODEL. Leer, E. (Tromsoe Univ. (Norway)). Solar Phys.; 35: No. 2, 467-480(Apr 1974).

A one-fluid model of the solar atmosphere is considered. The corona is heated by waves propagating out from the sun; and profiles for temperature, flow speed, and number density are obtained. For a relatively quiet Sun the inward heat flux in the inner corona is constant in $T \lesssim 5-6 \times 10^5$K, and the temperature maximum is reached for $r - R_\odot = 0.4$ to $0.5R_\odot$, where $R_\odot$ is the solar radius. The number density in the inner corona decreases with an increasing particle flux. (6 figures) (auth)

27850 A NOTE ON THE SOLUTION OF THE SATURATION FLUX LIMITED SOLAR WIND EQUATIONS. Roxburgh, I. W. (National Center for Atmospheric Research, Boulder, Colo. (USA)). Solar Phys.; 35: No. 2, 481-487(Apr 1974).

The solution curves of the differential equations determining

the behavior of the solar wind are calculated for the case where the heat flux has its maximum value $\frac{3}{2}$ nk $T v_{th}$. All the supersonic solutions are asymptotically adiabatic, $T \sim r^{-\frac{4}{3}}$. (1 figure) (auth)

27851 STUDIES OF GRANULAR VELOCITIES. IV. Statistical Analysis of Granular Doppler-Shifts. Mattig, W.; Nesis, A. (Fraunhofer Institut, Freiburg, F. R. Germany). Solar Phys.; 36: No. 1, 3-9(May 1974).

A statistical analysis of local Doppler shifts measured in the line λ6302.5 of Fe I is presented. The main results are the following: If the oscillatory component is separated from the fluctuations of velocity, a granular rms velocity of about 200 m s^{-1} is left over, which is strongly influenced by seeing. The results of the correlation analysis between brightness and velocity fluctuations reveals variations of granular structure with height in the photosphere. The granular velocities decrease with height in the photosphere, in agreement with inhomogeneous photospheric models. The average power spectra of brightness and velocity fluctuations show peaks at spatial wavelengths of 3.8″, 2.7″, 1.9″ and 1.3″. A regularity in these values is pointed out. (4 figures, 2 tables) (auth)

27852 THE SOLAR ABUNDANCE OF BERYLLIUM. Ross, J. E.; Aller, L. H. (California Univ., Los Angeles (USA)). Solar Phys.; 36: No. 1, 11-19(May 1974).

The solar abundance of beryllium is deduced from high-resolution Kitt Peak observations of the λ3130.43 and λ3131.08 lines of Be II interpreted by the method of spectrum synthesis. The results are in good agreement with those previously obtained by Grevesse and by Hauge and Engvold, and indicate that in the photospheric layers beryllium is depleted below the chondritic value by a factor of about two. It is found that $\{Be\} \equiv \log N(Be)/N(H) + 12 = 1.08$. (3 figures, 2 tables) (auth)

27853 THE SOLAR ABUNDANCE OF THULIUM. Research Note. Ross, J. E.; Aller, L. H. (California Univ., Los Angeles (USA)). Solar Phys.; 36: No. 1, 21-23(May 1974).

The solar spectrum contains one relatively unblended line λ3131.258 Tm II, which yields a thulium abundance of $\log N(Tm)/N(H) + 12 = \{Tm\} = 0.80 \pm 0.10$, with the Corliss and Bozman f-value. A recent beam–foil experiment suggests that the thulium abundance may be reduced to $\{Tm\} = 0.30$. (auth)

27854 THE [Ca II] λ7323.90 LINE IN THE SOLAR SPECTRUM. Day, R. W. (Texas Univ., Austin (USA)). Solar Phys.; 36: No. 1, 25-27(May 1974).

Grevesse and Swings (1968) and, independently, Lambert et al. (1969) identified the Ca II $4^2_{\frac{1}{2}}\ S_{\frac{1}{2}} - 3d^2\ D_{\frac{3}{2}}$ line at 7323.90 Å in the Sun. Unfortunately, this line usually appears as an asymmetry in a much stronger telluric water line at 7323.97 Å and is difficult to resolve. These telluric blending problems could be avoided if scans of a planet such as Mars were taken at a time when that planet's geocentric radial velocity shifted the forbidden Ca II line into a spectral region free of terrestrial lines. This should lead to a more accurate value for the equivalent width. This note reports such observations. This is the first time the Ca II line has been completely resolved from the nearby water line. The present observation is in accord with the model predictions of Lambert and Mallia (1969) if they are revised to account for a log gf value of −7.39 (Warner 1968) and the higher electron pressure resulting from the increased solar iron abundance found by Garz et al. (1971). It also shows no significant inconsistency with the most recent determination of the calcium abundance in the Sun, $\log N(Ca) = 6.36 \pm 0.07$, derived by Holweger (1972) from a wide variety of permitted calcium lines. (1 figure) (NL)

27855 COMPUTATION AND OBSERVATION OF ZEEMAN MULTIPLET POLARIZATION IN FRAUNHOFER LINES. III. Magnetic Field Structure of Spot Mt. Wilson 18488. Wittmann, A. (Goettingen Univ. (F. R. Germany)). Solar Phys.; 36: No. 1, 29-44(May 1974).

From an analysis of Stokes parameter profiles measured in a unipolar sunspot, properties of its large-scale magnetic field structure have been derived. With due allowance for our present knowledge about the Wilson effect and the height of line formation, an expression for the field strength distribution H(r,z) has been obtained. The corresponding field strength gradient equals $\partial H/\partial z = -1.5$ G km^{-1} at a height z = 300 km; it increases with decreasing z and vice versa. The inclination of the magnetic vector increases from $\Psi = 0°$ at r = 0 to $\Psi = 90°$ at the penumbra–photosphere border; its variation across the spot is not consistent with a purely radial (poloidal) field. The field azimuth has been determined across a sunspot diameter on several days with due allowance for the Macaluso–Corbino effect, and significant azimuthal components H_x have been found, especially in the umbra. (5 figures, 4 tables) (auth)

27856 A CORRECTION TO McALLISTER'S 1960 ATLAS OF THE SOLAR SPECTRUM. Chipman, E. G. (Colorado Univ., Boulder (USA)). Solar Phys.; 36: No. 1, 45-48(May 1974).

A comparison of the wavelengths listed on McAllister's (1960) atlas of the ultraviolet solar spectrum with those listed by Moore (1962) will show that in the range 1978 to 1989 Å the wavelengths of multiplet 7 of Si I are measured in air, while the wavelengths of the rest of the lines listed by McAllister in this region are measured in vacuum. Since the difference between air and vacuum wavelengths in this region is 0.65 Å, an appreciable error is introduced by mixing the two types of wavelengths. The wavelength scale has been redetermined by using vacuum wavelengths below 2000 Å. The wavelength correction which has been applied to the figures in McAllister's atlas is shown. (2 figures) (NL)

27857 AN INTERPRETATION OF THE CORRELATION IN THE INTENSITY FLUCTUATIONS IN H AND K OF Ca II AND b_1 OF Mg I. Research Note. Sivaraman, K. R. (Indian Inst. of Astrophysics, Kodaikanal). Solar Phys.; 36: No. 1, 49-50 (May 1974).

From a study of the intensity fluctuations in the continuum as well as in the lines H and K of Ca II, b_1 of Mg I and $H\beta$, Evans and Catalano (1972) have found that the correlation between the continuum structures and those in the inner wings of the lines of K and b_1 assumes negative values. Thomas (1972) has suggested an explanation based on the source functions. In this note, an interpretation derived from a study of the intensity oscillations in the continuum and in the Fe I 6358.695 line completed at Kodaikanal from an excellent time sequence around this region is offered. (NL)

27858 DIFFERENTIAL ROTATION OF SOLAR FILAMENTS. Glackin, D. L. (Hale Observatories, Pasadena, Calif. (USA)). Solar Phys.; 36: No. 1, 51-60(May 1974).

The latitudinal component of solar differential rotation and the possibility of a radial component are discussed and compared to the observed rotational velocities of solar filaments. The values of rotational rate versus heliographic latitude for 100 points in the solar atmosphere derived from 17 quiescent filaments are comparable to the rates found by d'Azambuja and d'Azambuja (1948). The filament rate is significantly greater than the spot rate (Newton and Nunn, 1951); the difference cannot be accounted for by the poleward migration of filaments, and seems to reflect a true radial gradient of rotational velocity in the Sun. It is shown that filaments in closer proximity to active regions usually exhibit no differential rotation, while those far from active regions generally show it clearly. Comparison with Mt. Wilson photospheric Doppler measurements shows that filaments rotate faster than the general photosphere and that, as is well known, the spot rate exceeds that for the general photosphere. (3 figures, 3 tables) (auth)

27859 COMMENTS ON "SOLAR POLAR SPINDOWN," BY KENNETH SCHATTEN. Research Note. Gilman, P. A. (National Center for Atmospheric Research, Boulder, Colo. (USA)). Solar Phys.; 36: No. 1, 61-64(May 1974).

Schatten (1973) has purported to show that it is possible for the observed surface differential rotation of the Sun to be explained as being due to differential solar wind torques. It is argued in this note that the conclusions Schatten has drawn are untenable. Schatten has ignored a number of important observations, ignored much of the published literature concerning theoretical fluid dynamics applied to the solar convection and differential rotation problem, and made some highly unreasonable assumptions concerning the nature of convective turbulence. The result was a gross underestimate of the strength of turbulent mixing in the convection zone. (NL)

27860 PHOTOELECTRIC DRIFT SCANS II: TIME PULSE EVALUATION, LIMB PROFILES, AND THE SOLAR DIAMETER (RESEARCH NOTE). Wittmann, A. (Goettingen Univ. (F. R. Germany)). Solar Phys.; 36: No. 1, 65-68(May 1974).

The method of computer-controlled photoelectric drift scans has been improved by virtue of a new timing technique allowing for an accuracy of 4 ms or, equivalently, 50 km on the Sun. With this technique, a previous result for the solar semidiameter was confirmed: R = 960.277″. The extreme solar limb intensity profile at 5012 Å was derived from drift scans. A comparison with the computed profile was made, and parameters for the base of the chromosphere were derived. (1 figure) (auth)

27861 THE CONTINUUM OF THE EXTREME LIMB AND THE CHROMOSPHERE AT THE 1970 ECLIPSE. Kurokawa, H.; Nakayama, K.; Kanno, M. (Kyoto Univ. (Japan)); Tsubaki, T. (Shiga Univ., Ohtsu, (Japan). Inst. of Earth Science and Astrophysics). Solar Phys.; 36: No. 1, 69-79(May 1974).

The flash spectra of the partial Sun and the chromosphere were obtained at the total solar eclipse on 7 March 1970. The distributions of the surface brightness of the continuum were studied at six wavelengths in the visual region and compared with the previous observations and the existing model atmospheres. All of the distributions show a shallow dip and a small hump similar to those of Heintze's observation at the 1954 eclipse, but the hump in these results is of quite a different type from that given by Heintze's revised model. It was found that none of the existing model atmospheres can reproduce this hump. The intensity distribution in the low chromosphere was also examined. (5 figures) (auth)

27862 POLARIZATION OF LIGHT; AT THE EDGE OF THE SOLAR DISC, IN THE NEAR INFRARED. (Research note). Leroy, J. L. (Observatoire du Pic du Midi, 65–Bagneres-de-Bigorre (France)). Solar Phys.; 36: No. 1, 81-84(May 1974). (In French).

The polarization of light observed near the Sun's limb goes down steeply from the blue to the red part of the spectrum. New measurements performed through near-infrared filters have shown that this behavior holds up to 8000 Å. On the other hand, it is found that the proportion of polarized light remains nearly constant between 8000 and 10,000 Å; it is about 15 millionths at 25″ from the limb, at least if the measurements have not been biased by any unknown polarizing process in the terrestrial atmosphere. (auth)

27863 HIGH N EMISSION AND ABSORPTION LINES OF THE SUN. Greve, A. (Max-Planck-Institut fuer Radioastronomie, Bonn (F.R. Germany)). Solar Phys.; 36: No. 1, 85-90(May 1974).

Due to the expected peaks of the b_n curves of ions in the chromosphere–corona transition region and the corona, high-n transition lines change from emission to absorption in the wavelength region from $\approx 1/2$ mm for elements in a low state of ionization to ≈ 2 mm for elements in a high state of ionization. The observational consequences are discussed. It is thought that lines have not yet been found because the observations were made too close to the wavelength region where the lines change from emission to absorption and therefore disappear. (3 figures) (auth)

27864 BRIGHT PHOTOSPHERIC AREAS SURROUNDING SUNSPOT GROUPS AT 5700 A. Miller, R. A. (Manila Observatory, Manila, Philippines). Solar Phys.; 36: No. 1, 91-99(May 1974).

Sunspot groups at various central angles were chosen to study what appears to be an enhanced surrounding area, even at small central angles. The continuous band of observation was 200 Å wide, centered at 5700 Å. The enhancement has been seen before, but only at higher frequencies, as by Jayanthan in the ultraviolet. Four years of sunspot pictures, from March 1957 to March 1961, were inspected, and no instance of the nonappearance of the enhancement was noted. An attempt to show proof was made by photometry and by high-contrast prints of the areas around groups at different central angles. It was shown that more than half of the flux deficit reappears in this enhancement. (4 figures) (auth)

27865 THE TEMPERATURE OF PENUMBRAL FILAMENTS. Kjeldseth Moe, O.; Maltby, P. (Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk). Solar Phys.; 36: No. 1, 101-108 (May 1974).

The intensity of individual penumbral filaments has recently been measured at the Pic-du-Midi Observatory as well as from observations obtained during the third flight of the Soviet Stratospheric Solar Station. The results of these measurements are used to calculate the corresponding average penumbral intensity as function of wavelength. The calculated average intensity is compared with the average intensity observed at the Oslo Solar Observatory. The Pic-du-Midi observations are supported by this comparison. The run of temperature versus optical depth is given for bright and dark penumbral filaments. The variation of gas pressure with geometrical depth is discussed. It is suggested that the magnetic field direction has a different variation with depth in bright and dark filaments. (2 figures, (auth)

27866 MODELS FOR DIFFERENT SUNSPOT UMBRAE. Kjeldseth Moe, O.; Maltby, P. (Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk). Solar Phys.; 36: No. 1, 109-114 (May 1974).

The recently detected intensity difference between individual, large sunspots in the infrared spectral region is considered. It is shown that the intensity difference may be explained by a temperature difference of 140 to 160°K in the upper atmosphere with the temperature nearly unchanged below an optical depth approximately equal to unity. The change in temperature in the upper layers alters the observability of the deeper layers and the corresponding intensity. (2 figures, 1 table) (auth)

27867 GREEN CORONA AND SOLAR SECTOR STRUCTURE. Antonucci, E.; Svalgaard, L. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Solar Phys.; 36: No. 1, 115-120(May 1974).

Analysis of the green-line corona for the interval 1947 to 1970 suggests the existence of large-scale organization of the emission. The green-line emission at high northern latitudes ($\approx 40°$ to 60°) is correlated with the emission at high southern latitudes 6, 15 and 24 days later, while the low-latitude green corona seems to be correlated on both sides of the equator with no time lag. These coronal features are recurrent with a 27-day period at all latitudes between ±60°, and these large-scale structures are associated with the solar magnetic sector structure. The high correlation between northern and southern high-latitude emission at 15 days time lag is explained as a signature of a two-sector structure, while four sectors are associated with the 6- and 24-day peaks. (3 figures) (auth)

27868 ON HELIUM-LIKE $1s2l-1snl'$ TRANSITIONS IN SOLAR FLARE SPECTRA. Kastner, S. O.; Neupert, W. M.; Swartz, M. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Solar Phys.; 36: No. 1, 121-128(May 1974).

Expected wavelengths and intensities are computed for $1s2l-1snl'$ transitions in helium-like ions of the abundant elements from oxygen to iron, under coronal conditions. Probable observations of some of these lines in the spectra of solar flares are discussed, and attention is called to a possible reversal of singlet and triplet intensities as compared to laboratory observations. (1 figure, 7 tables) (auth)

27869 NEUTRON PROPAGATION AND 2.2 MeV GAMMA-RAY LINE PRODUCTION IN THE SOLAR ATMOSPHERE. Wang, H. T. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy); Ramaty, R. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Solar Phys.; 36: No. 1, 129-137(May 1974).

The 2.2-MeV gamma-ray line intensity from the Sun has been calculated by using a Monte Carlo method for neutron propagation in the solar atmosphere. Detailed results are provided on the total gamma-ray yield per neutron and on the time profile of the 2.2-MeV line from an instantaneous and monoenergetic neutron source. The parameters which have the most significant effects on the line intensity are the energies of the neutrons, the position of the neutron source on the Sun, and the abundance of ^{3}He in the photosphere. For an isotropic neutron source which is not too close to the limb of the Sun, the gamma-ray yield is between about 0.02 to 0.2 photons per neutron, provided that the neutron energies are in the range 1 to 100 MeV and the ratio ^{3}He/H is less than about 5×10^{-4}. (4 figures, 1 table) (auth)

27870 COOLING OF SOLAR FLARE PLASMAS. Zaumen, W. T.; Acton, L. W. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). Solar Phys.; 36: No. 1, 139-144(May 1974).

A simple model for the cooling of solar flare plasmas is considered. This model predicts that an increase in emission measure with decreasing temperature is a general feature of a cooling flare. The results are compared to solar flare data. (2 figures) (auth)

27871 A PROBABLE MEAN TRANSIT TIME OF THE FLARE-GENERATED DISTURBANCES. Nita, I. D. (Astronomical Observatory, Bucharest, Rumania). Solar Phys.; 36: No. 1, 145-149 (May 1974).

A probable mean transit time of solar disturbances producing magnetic storms with sudden commencement (SSC) was obtained by using the correlation method. The 72-h period that preceded a SSC was divided into six equal intervals. For each of them correlation coefficients between a solar flare index and SSC indices were calculated; maximum value was obtained for the interval between 36 and 48 h. For a more accurate determination, this interval was subdivided into four smaller parts, and new correlation coefficients were calculated. This refined procedure gave 39 to 42 h as the most probable value of the mean transit time of the solar disturbances producing SSC's; this involves a mean propagation speed of about 1000 kms^{-1} inside 1 AU. (4 tables) (auth)

27872 CORRELATION OF A FLARE-WAVE AND TYPE II BURST. Harvey, K. L.; Martin, S. F. (Lockheed Solar Observatory, Burbank, Calif., USA); Riddle, A. C. Solar Phys.; 36: No. 1, 151-155(May 1974).

The relation of a flare-induced wave and the type II and III radio bursts associated with the 26 April 1969, 2258 UT flare have been studied. The observations suggest the flare-wave and type II bursts were produced by a common source. (2 figures, 1 table) (auth)

27873 A COHERENT RADIATION MECHANISM FOR TYPE IV dm RADIO BURSTS. Kuijpers, J. (Sterrekundig Instituut, Utrecht, The Netherlands). Solar Phys.; 36: No. 1, 157-169 (May 1974).

An interpretation is presented of the decimetric type IV continuum with fine structure on March 6, 1972, and of the corre-

sponding source region, in terms of Cherenkov plasma radiation and alternatively of synchrotron radiation, for both coherent and incoherent generation. If the magnetic field strength in the source region is a few gauss, in a stationary situation a loss cone instability develops which generates electron plasma waves coherently. The amount of energetic electrons required for consecutive induced scattering of the plasma waves at the thermal ions into electromagnetic waves is less than in case of synchrotron radiation. It is concluded that the former mechanism provides the explanation of type IV continua with fine structure, such as intermediate drift bursts and sudden reductions of the continuum level. (auth)

27874 SOLAR LONGITUDE DEPENDENCE OF SOME CHARACTERISTICS OF TYPE III RADIO BURSTS FROM METRIC TO HECTOMETRIC WAVELENGTHS. Sakurai, K. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Solar Phys.; 36: No. 1, 171-178(May 1974).

By using the observed data for metric and hectometric type III radio bursts, the dependence of burst characteristics on the solar longitude has been examined over a wide frequency range. It is found that there exists an east–west asymmetry for the extension of metric type III bursts into the hectometric wavelength range. In particular, hectometric bursts are rarely observed for solar flares associated with metric bursts eastward solar longitude 60°E. Furthermore, for eastern longitudes, the low frequency radio observations show a large dispersion in drift time interval. (5 figures) (auth)

27875 METER AND DECAMETER WAVELENGTH POSITIONS OF SOLAR BURSTS OF JULY 31–AUGUST 7, 1972. Kundu, M. R.; Erickson, W. C. (Maryland Univ., College Park (USA)). Solar Phys.; 36: No. 1, 179-189(May 1974).

The positional analysis of solar bursts at meter and decameter wavelengths observed during the period July 31 to August 7, 1972, is presented. Most of the activity during this period was associated with the active regions McMath 11976 and 11970. Except near the CMP of region 11976, two regions of continuum emission were observed—one, a relatively smooth continuum, and the other, a continuum superimposed with many type III's and other fine structure. It seems possible to interpret these continua in terms of plasma waves originating from two sources located at different heights or with different electron density gradients. The angular size of type III sources seems to increase with decreasing frequency. This result implies that the open field lines along which the type III electrons travel have larger angular extent at greater heights. (5 figures) (auth)

27876 THE STRUCTURE OF THE MIDDLE CORONA FROM OBSERVATIONS AT 80 AND 160 MHz. Dulk, G. A.; Sheridan, K. V. (Commonwealth Scientific and Industrial Research Organization, Epping (Australia). Div. of Radiophysics). Solar Phys.; 36: No. 1, 191-202(May 1974).

Maps of the brightness distribution of the "Quiet Sun" at 80 and 160 MHz reveal the presence of features both brighter and darker than average. The "dark" regions are well correlated with dark regions on uv maps; it is deduced that they result from "coronal holes". The "bright" regions are associated with quiescent filaments and not plages or bright regions on microwave or uv maps; it is deduced that they result from "coronal helmets". When coronal holes appear near the centre of the disk, one can estimate the density and kinetic temperature in the holes from the radio observations. For a hole observed on 1972 July 20–21, it is found that $T \sim 0.8 \times 10^6$ inside the hole and $T \sim 1.0 \times 10^6$ in average regions outside the hole. Inside the hole the density is estimated to be about one-quarter of that in Newkirk's model of the spherically symmetric corona. Variations in brightness at a fixed height above the limb are generally well correlated with scans at a similar height made with a K-coronameter. Occasional differences may result from streamers protruding beyond the limb from the back of the Sun. These can be seen by the K-coronameter but, because of refraction of the radio rays, not by the radio-heliograph. (3 figures) (auth)

27877 OBSERVATIONS OF CORONAL DISTURBANCES FROM 1 TO 9 SOLAR RADII. I. First Event of 1973 January 11. Stewart, R. T.; McCabe, M. K. (Hawaii Univ., Honolulu (USA)); Koomen, M. J. (Naval Research Lab., Washington, D.C. (USA)); Hansen, R. T. (National Center for Atmospheric Research, Boulder, Colo. (USA)); Dulk, G. A. (Commonwealth Scientific and Industrial Research Organization, Epping (Australia). Div. of Radiophysics). Solar Phys.; 36: No. 1, 203-217(May 1974).

Hα, white-light and radio observations of a coronal disturbance on 1973 January 11 commencing at about 00^h36^m UT show that a piston-driven shock wave propagated outwards through the corona to heights of at least 9 $R_\odot$. Probably most of the expelled coronal gas originated in a coronal enhancement in the lower corona. The estimate of the kinetic energy and the mass of the expelled gas is compatible with observations of piston-driven shock waves near the Earth. Shock-wave parameters are evaluated, and a model of the disturbance is outlined. (7 figures) (auth)

27878 OBSERVATIONS OF CORONAL DISTURBANCES FROM 1 TO 9 SOLAR RADII. II. Second Event of 1973 January 11. Stewart, R. T. (Hawaii Univ., Honolulu (USA)); Howard, R. A. (Naval Research Lab., Washington, D.C. (USA)); Hansen, F. (National Center for Atmospheric Research, Boulder, Colo. (USA)); Gergely, T.; Kundu, M. (Maryland Univ., College Park (USA)). Solar Phys.; 36: No. 1, 219-231(May 1974).

Observations of a coronal disturbance on 1973 January 11 commencing at 18^h01^m UT are described. The event is homologous with an earlier disturbance from the same region of the corona. The observations suggest that a cloud of coronal gas containing $\sim 4 \times 10^{39}$ electrons propagated outwards to ≥ 5 $R_\odot$ behind a piston-driven shock wave travelling at a velocity of 800 to 1200 km s^{-1}. (8 figures) (auth)

Galaxies

Refer also to abstracts 27657, 27660, and 27704.

27879 (AD-773573) STUDY OF THE HI ABSORPTION IN THE GALAXY M82 BY RADIO INTERFEROMETRY. Report No. 1973-16. Weliachew, L. (Owens Valley Radio Observatory, Pasadena, Calif. (USA)). 1973. Contract N00014-67-A-0094-0019. 25p. NTIS $3.00.

The continuum source located in the IrrII galaxy M82 has been studied in HI absorption at 21 cm wavelength. Absorption by gas located in M82 has been detected and mapped with an east-west interferometer. The maximum baseline length was approximately 4500 lambda. The velocity resolution was 21 km/sec. The positions of fifteen velocity centroids of the HI absorption have been determined to within 1-3 arc/sec accuracy relative to one another. This allows direct comparison with a recent optical study (Heckathorn 1972). For the first time agreement is found between the systemic velocities of M82 determined by optical and radio methods. Several features of the velocity field are discussed particularly in the framework of the dust-scattering models recently proposed for M82. (GRA)

27880 THE KINEMATICS AND DYNAMICS OF M51. I. THE OBSERVATIONS. Tully, R.B. (Astronomy Program, University of Maryland, College Park). Astrophys. J. Suppl. Ser. 27: No. 251, 415-435 (May 1974).

A photographic Fabry–Perot interferometer has been used to obtain a detailed velocity map of the spiral galaxy M51. The instrument, observations, and reduction procedures are described, and the Hα intensity distribution and line-of-sight velocities are reported wherever the intensity exceeds 1×10^{-14} ergs s^{-1} cm^{-2}. Intensities as low as 3×10^{-15} ergs s^{-1} cm^{-2} have been observed (corresponding to an emission measure of 30 cm^{-6} pc if $T = 10^4$°K). Except near the edges of the field, velocities should be accurate to ± 8 km s^{-1} (rms). (auth)

27881 THE KINEMATICS AND DYNAMICS OF M51. II. AXISYMMETRIC PROPERTIES. Tully, R.B. (Astronomy Program, University of Maryland, College Park). Astrophys. J. Suppl. Ser. 27: No. 251, 437-448 (May 1974).

A simple model in which the distribution of matter is described by two Gaussian components is consistent with the rotational velocities observed in the spiral galaxy M51. The two components can be associated with the disk of the galaxy and a less-flattened nuclear lens. A third Gaussian component, associated with the optical semistellar nucleus, is required to explain the wide emission lines observed at the center of M51. Together, the three components lead to a surface density of matter which is inversely dependent on the radius over the inner disk. This configuration has been theoretically anticipated because it is radially stable. There is a discussion of the distribution of angular momentum, rotational kinetic energy, and ionized hydrogen and a discussion of the thickness of a stable gaseous disk in this galaxy. (auth)

27882 THE KINEMATICS AND DYNAMICS OF M51. III. THE SPIRAL STRUCTURE. Tully, R. B. (Astronomy Program, University of Maryland, College Park). Astrophys. J. Suppl. Ser. 27: No. 251, 449-471 (May 1974).

A detailed model is presented which explains the origin and nature of the spiral structure of M51 and the peculiar velocities observed in the nuclear region of the galaxy. In this model, the outer spiral arms are material arms, the tidal consequences of the close passage of NGC 5195. A density wave has been generated by the innermost material clumping arising from the encounter, and this wave has propagated inward until it reached the inner Lindblad resonance at a radius of 600 pc. There, an elongated dispersion ring has formed, accounting for the apparent "outflow" of gas in the nuclear region of M51. The time scale

for the propagation of the density wave is less than 10^8 years, and 1 is comparable to the time scale for the close approach of the companion. Over most of its existence, M51 was not such a spectacular spiral galaxy as it is today. (auth)

27883 VIBRATIONALLY EXCITED SILICON MONOXIDE IN THE ORION NEBULA. Davis, J.H.; Blair, G.N.; Van Till, H. (University of Texas at Austin); Thaddeus, P. Astrophys. J. Lett. 190: No. 3, L117-L119 (15 June 1974).

A 1° K line has been detected in the center of the molecular cloud in the Orion Nebula which is probably the 129,363.1-MHz, J=3→2 rotational transition of SiO in its first excited (v=1) vibrational state. The LSR radial velocity based on this assignment is 15.3 km s^{-1}, which is exactly that of the second strongest of the seven lines at 86.2 GHz recently found by Snyder and Buhl, and attributed by them to maser emission by the v=1, J=2→1 transition of SiO. We have been unable to detect vibrationally excited SiO in any other source at 129 GHz, and a search for the v=1, J=1→0 line of CO has also proved unsuccessful. (auth)

27884 ON DETECTING COLD, LOW-DENSITY INTERSTELLAR GAS. Weisheit, J.C. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Astrophys. J. Lett. 190: No. 3, L121-L123 (15 June 1974).

In contrast to existing steady-state models, a recent time-dependent model of the interstellar medium predicts that some of the intercloud gas has a low temperature, T < 50°K, but a high fractional ionization. A region of cold intercloud gas produces broad, shallow absorption lines. We point out that Hobb's very high resolution scans of interstellar Na I D lines in the spectra of hot stars are consistent with the existence of cold intercloud gas in the direction of the Orion association, and we describe additional Na I observations which could detect other regions of cold intercloud gas. (auth)

27885 CO AND CS IN THE ORION NEBULA. Liszt, H.S. (Princeton University Observatory); Wilson, R.W.; Penzias, A.A.; Jefferts, K.B.; Wannier, P.G.; Solomon, P.M. Astrophys. J. 190: No. 3, 557-564 (15 June 1974).

We present maps, in $^{12}C^{16}O$, $^{13}C^{16}O$, and $^{12}C^{32}S$ line emission, of the central (~20') portion of the Orion A molecular cloud. The dominant feature in the maps is a dense 4' X 9' emission "ridge" which appears to be rotating about an east-west axis running through the position of the Kleinmann-Low infrared source. We argue that our line profiles and maps are most readily understood in terms of simple, systematic, radial velocity structure in the cloud. (auth)

27886 OBSERVATIONAL EVIDENCE FOR THE EXCITATION OF HCN AND H_2O IN PROTOSTELLAR MOLECULAR CLOUDS. Clark, F.O. (Astronomy Department, University of Virginia, Charlottesville, Virginia 22903); Buhl, D.; Snyder, L.E. Astrophys. J. 190: No. 3, 545-556 (15 June 1974).

Detailed modeling of the molecular cloud and excitation of HCN in the Orion Nebula have been compared with HCN observations. This results in information about the density distribution of the cloud, collisional interaction of H_2 with HCN, number densities, kinetic temperature, cloud mass, upper age limit, and molecular isotopic ratios. It is found that the $^1H^{12}C^{14}NJ=1-0$ transition is not saturated and that the molecular isotopic ratios do not reflect terrestrial elemental ratios. These results are combined with VLB observations of H_2O masers in Orion and detailed H_2O excitation calculations of others to produce a consistent interpretation of the Orion molecular cloud. (auth)

27887 ON THE STABILITY OF A DISK GALAXY. Miller, R.H. (Department of Astronomy and Astrophysics, The University of Chicago, 1100-14 East 58th Street, Chicago, Illinois 60637). Astrophys. J. 190: No. 3, 539-542 (15 June 1974).

Numerical experiments on strictly axisymmetric disk galaxies are reported which confirm the stability threshold predicted by Toomre. This provides strong evidence that the difference between the Toomre criterion and the experimental behavior of disk-galaxy models in a computer is attributable to non-axisymmetric disturbances. The implications of this result for disk-galaxy models in general are discussed, along with applications to models of the Galaxy. (auth)

27888 DECREASE IN ROTATIONAL VELOCITY WITH INCREASING OBLATENESS OF FLAT GALAXIES. Vorontsov-Vel'yaminov, B.A. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 6, 834-835 (May 1974).

It has long been held that the rotation of stellar systems should accelerate as their oblateness a/c increases. In 1970 the author found an opposite behavior, for 14 objects; that result is now confirmed by values of a/c for 40 galaxies, mostly determined photometrically. (auth)

27889 DENSITY OF HIGH-ENERGY ELECTRONS AND MAGNETIC-FIELD STRENGTH AT THE GALACTIC CENTER. Stepanyan, A.A. (Crimean Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.-AJ 17: No. 6, 830-832 (May 1974).

Measurements of the radio-wave, infrared, and γ-ray flux from the galactic center yield estimates for the density of high-energy electrons and the field strength. The electron density at the galactic center is no more than 40 times the density at the earth; the field strength is at least $2 \cdot 10^{-5}$ gauss. Estimates are also obtained for the cosmic-ray diffusion time out of the galactic-center region and the power of the cosmic-ray source. The diffusion time is at least $3 \cdot 10^4$ yr. If the density of the nuclear cosmic-ray component at the galactic center is assumed to be 100 times the density of the electron component, the power of the source would be $\simeq 10^{40}$ ergs/sec. (auth)

27890 ANGULAR MOMENTUM PER UNIT MASS FOR SPIRAL GALAXIES. Savchenko, V.P. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 6, 743-748 (May 1974).

The angular momentum $\tilde{K}$ per unit mass and the total mass M are calculated from the Burbidges' model for 20 spiral galaxies and Brandt's model for 28 spirals. The latter model seriously overestimates these quantities. $\tilde{K}$ and M alone will not uniquely specify the morphological type of a spiral. Correlations between $\tilde{K}$, M, and the radius r indicate that $\tilde{K} \propto M^{3/4}$ and $r \propto M^{1/2}$. A discussion is given of Crampin and Hoyle's theory that disks of spiral galaxies are formed when homogeneous gas clouds in solid-body rotation collapse with conservation of angular momentum. Massive disks would have condensed from protoclouds of relatively low density, large radius, and low angular rotational velocity. A simple statistical relation is obtained between the mass of a galaxy within a given distance from the center in the equatorial plane and the rotational velocity at that distance. (auth)

27891 REDDENING EFFECT IN CENTRAL REGIONS OF NORMAL GALAXIES. Metik, L. P.; Pronik, I. I. Izv. Krym. Astrofiz. Observ.; 49: 86-88(1974). (In Russian).

The reddening of the central regions for 81 normal galaxies has been estimated by comparing the central regions colour indexes to that of the bluest ones. If the reddening effect in central regions is due to interstellar dust, the upper limit of dust content in central regions equals to some units 10^5 $M_\odot$. (auth)

27892 INFLUENCE OF SOLAR ACTIVITY ON THE COAST EFFECT IN THE IONOSPHERE. Dmitriev, A. A. (Moscow Inst. of Geodesic Engineering, Aerial Photographic Survey, and Cartography). Dokl. Akad. Nauk SSSR; 212: No. 3, 600-602 (21 Sep 1973). (In Russian).

The effect of rapidly changing magnetic fields of the solar wind hitting the earth on the wind velocity in the ionosphere was examined. Measured wind velocities are close to the mathematical evaluation made. (JSR)

27893 STUDY OF THE DENSITY WAVE UNDER THE INFLUENCE OF THE GALACTIC MAGNETIC FIELD: THREE DIMENSIONAL CASE. Saha, G. (Jadavpur Univ., Calcutta). Indian J. Phys.; 48: No. 3, 203-214(Mar 1974).

The linearized three-dimensional magnetohydrodynamical equations with perturbation were solved and the amplitudes of density, potential, velocity, and magnetic field perturbations were calculated over the entire galactic plane. It is observed that the radial velocity perturbation increases approximately smoothly towards the center, while the tangential and perpendicular velocity components decay out there. This is relevant to the observation of large radial flow of gas in the central region of the galaxy. In the 3-kpc region, the perturbation in magnetic field components are very high. This means that the galaxy may have regions of very large perturbation with the consequent unusual dynamical behavior of matter in such regions. (auth)

27894 NARROW-BAND OBSERVATIONS OF GALACTIC AND EXTRAGALACTIC SOURCES AT 1 mm. Clegg, P. E.; Ade, P. A. R.; Rowan-Robinson, M. (Queen Mary Coll., London). Nature (London); 249: No. 5457, 530-532(7 Jun 1974).

The results of a search for discrete extragalactic sources of continuum radiation near 1.2 mm are described. The observations were made with the National Radio Astronomy Observatory 11 m telescope at Kitt Peak, Arizona, in conjunction with the NRAO 1 mm continuum receiver. Observations of a total of 90 known extragalactic objects were attempted: three were probably detected, and two were possibly detected. These five objects comprised two quasars, a Seyfert galaxy, an N galaxy, and unidentified radio source. Observations were also made of well known galactic regions and mm emission was found in several. The observations represent the first of extragalactic sources than can be genuinely described as giving narrow band fluxes close to 1 mm. Flux scales were determined for the sources, together with atmospheric attenuation. The impression was obtained that a similar phenomenon was being observed in most of the objects, namely a flux density rising steeply with frequency in the mm region. (UK)

27895 RELATION BETWEEN THE MASS/LUMINOSITY RATIO AND COLOR INDEX FOR ROTATING GALAXIES. Zasov, A.V.; Mossakovskaya, L.V. (Shternberg Astronomical Institute, Moscow). Sov. Astron.—AJ 18: No. 1, 39-41 (July 1974).

A relation is obtained between the mass/luminosity ratio and the color index C_0 for the regions of nonelliptical galaxies inside the radius R_m corresponding to the maximum rotational velocity V_m of the galaxy. For most such galaxies the mass functions of the stars in these regions should either be the same or vary monotonically along the color sequence. (auth)

27896 STABILITY OF GRAVITATING SYSTEMS WITH A QUADRATIC POTENTIAL. III. COLLISIONLESS BIAXIAL AND TRIAXIAL ELLIPSOIDAL STELLAR SYSTEMS. Morozov, A.G.; Polyachenko, V.L.; Shukhman, I.G. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio—Wave Propagation, Siberian Branch, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 1, 44-48 (July 1974).

Freeman's triaxial model ellipsoid for barred spiral galaxies is considered. This model received persuasive observational support when Freeman and the de Vaucouleurs detected "countercurrents" in the barred spiral NGC 4027, as predicted by the theory. The boundary separating the domains of stable and unstable solutions is established. Ellipsoids with observed values for the axial ratio are shown to be stable. The growth rates of the unstable solutions are calculated. These results indicate that Freeman's model can serve as a basis for developing a satisfactory theory of barred spirals. Exact eigenfunctions and oscillation frequencies are obtained for a collisionless stellar ellipsoid of revolution with arbitrary flattening. Although the curves of equal perturbed density represent "weakly leading" spirals, the partial density due to stars of the flattest subsystems exhibits well—defined trailing spiral arms. This result agrees with the observational evidence that spiral structure consists only of gas and young stars belonging to the flattest subsystems, and with the numerical experiments of Miller et al., who have modeled the evolution of disk galaxies. (auth)

27897 ALIGNMENT OF INTERSTELLAR AND INTERPLANETARY GRAINS. Dolginov, A.Z. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR). Sov. Astron.—AJ 18: No. 1, 33-38 (July 1974).

Explicit equations are obtained for the distribution of the orientations of interstellar and interplanetary grains in an anisotropic particle or radiation flux, with allowance for precession in a magnetic field. Alignment is possible in a medium with a temperature anisotropy, as is usually the case for nonequilibrium plasma in a magnetic field. Small inhomogeneous grains, as well as molecular conglomerates, should usually be optically active, with a particular rotation of the polarization plane, and the orientation of these particles is considered. The alignment time is estimated. Possibilities for explaining interstellar polarization and the polarization of cometary radiation are discussed. (auth)

27898 LIMITS ON IONIZED INTRACLUSTER GAS IN ABELL 2199. Davidsen, A.; Welch, W. (Astronomy Department, Space Sciences Laboratory, Radio Astronomy Laboratory, University of California, Berkeley). Astrophys. J. Lett. 191: No. 1, L11-L12 (1 July 1974).

We have obtained an upper limit on the brightness temperature at 23 GHz in the core of the rich cluster Abell 2199. When combined with X—ray observations, our results indicate that there is probably not enough ionized gas present to gravitationally bind the cluster. Low—energy X—ray observations are required to strengthen this conclusion. (auth)

27899 MARKARIAN 348: A VARIABLE RADIO SOURCE. Sramek, R.A. (National Radio Astronomy Observatory, Green Bank, West Virginia 22901); Tovmassian, H.M. Astrophys. J. Lett. 191: No. 1, L13-L14 (1 July 1974).

Markarian 348 is a Seyfert—type galaxy with both low radio and optical luminosity. Variations in the radio flux density are reported here which enhance its resemblance to the strong radio Seyfert galaxies 3C 84 and 3C 120. Between 1972 August and 1973 September the flux at 3.7 cm decreased by 45 percent and the flux at 6.0 cm decreased by 32 percent while the flux at 11.1 cm held constant. The data are consistent with an optically thick, expanding synchrotron source, but so far only upper limits can be given for the model parameters. (auth)

27900 10—MICRON OBSERVATIONS OF SOUTHERN—HEMISPHERE GALAXIES. Kleinmann, D.E.; Wright, E.L. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. Lett. 191: No. 1, L19-L20 (1 July 1974).

Sensitive measurements of seven southern galaxies are reported, including four that were observed for the first time at 10 μ. Three of the four are Seyfert galaxies; among them is I4329 A, which is spectroscopically the most extreme Seyfert now known. The infrared data indicate that this galaxy will be found to have a complex, variable radio spectrum. The data suggest that M83 is extended at 10 μ, but they do not define its size. (auth)

27901 FILAMENTS FROM THE GALAXY NGC 1569. Hodge, P.W. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. Lett. 191: No. 1, L21-L22 (1 July 1974).

On Hα plates, the irregular galaxy NGC 1569 has an extensive filamentary system reaching out to twice the radius of the galaxy. The entire galaxy is enveloped in intense hydrogen emission. (auth)

27902 LARGE—SCALE WAVE STRUCTURE IN THE ORION MOLECULAR CLOUD. Phillips, T.G. (Queen Mary College, University of London); Jefferts, K.B.; Wannier, P.G.; Ade, P.A.R. Astrophys. J. Lett. 191: No. 1, L31-L32 (1 July 1974).

High—accuracy mapping of the Orion Nebula at the 1.3—mm CO (J=2—1) line has revealed well—defined oscillatory structure which may indicate gravitational instabilities in the molecular cloud on the scale of light years. (auth)

27903 350—MICRON MAPPING OF THE ORION MOLECULAR CLOUD. Gezari, D.Y.; Joyce, R.R.; Righini, G.; Simon, M. (Department of Earth and Space Sciences, State University of New York, Stony Brook). Astrophys. J. Lett. 191: No. 1, L33-L35 (1 July 1974).

We have mapped the central part of M42 at 350 μ with 56″ resolution. The distribution of 350—μ emission is similar to that of the core of the molecular cloud, indicating that this component of the submillimeter radiation from Orion is thermal radiation from the dust grains within the molecular cloud. The 350—μ optical depth at the peak of the source is 0.1 to 0.2 for a reasonable choice of temperatures. The observational spectrum between 1 mm and 91 μ indicates that the frequency dependence of the dust opacity is $\tau \propto \nu^{\beta}$, with $\beta \simeq 2$. (auth)

27904 LABORATORY MEASUREMENTS OF SOME ION—MOLECULE REACTIONS RELATED TO THE FORMATION OF HCN IN DENSE INTERSTELLAR CLOUDS. Schiff, H.I.; Hemsworth, R.S.; Payzant, J.D.; Bohme, D.K. (Department of Chemistry and Centre for Research in Experimental Space Science, York University). Astrophys. J. Lett. 191: No. 1, L49-L50 (1 July 1974).

Recent models have attributed the formation of HCN in dense, interstellar clouds to dissociative recombination of H_2CN^+ ions formed by the reaction of C^+ ions with NH_3. We have studied this reaction in the laboratory at 297°K and found the rate constant to be $(2.3 \pm 0.2) \times 10^{-9}$ cm^3 s^{-1}. However, only about 5 percent of the reaction produced H_2CN^+ while the remaining 95 percent produced NH_3^+ by charge transfer. We also found that the reaction of NH_3^+ with H_2, postulated in the model as the only source of NH_3, has a rate constant equal to $(4 \pm 2) \times 10^{-13}$ cm^3 s^{-1}. (auth)

27905 RADIO DETECTION OF INTERSTELLAR DIMETHYL ETHER. Snyder, L.E. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80302); Buhl, D.; Schwartz, P.R.; Clark, F.O.; Johnson, D.R.; Lovas, F.J.; Giguere, P.T. Astrophys. J. Lett. 191: No. 2, L79-L82 (15 July 1974).

Interstellar dimethyl ether, $(CH_3)_2O$, has been detected in emission from the direction of the Orion Nebula molecular cloud. The observed velocity of the $6_{06} \rightarrow 5_{15}$ transition at 90.9 GHz is in excellent agreement with other molecules observed toward Orion. Observations of the $2_{20} \rightarrow 2_{11}$ transition at 86.2 GHz and the $2_{11} \rightarrow 2_{02}$ at 31.1 GHz support the dimethyl ether detection and indicate that either $(CH_3)_2O$ has two distinct velocity components in Orion or certain internal motion states are preferentially populated. This molecule has a large collisional cross—section and C_{2v} symmetry; hence it should be useful for future studies of molecular pumping models. (auth)

27906 SUBMILLIMETER OBSERVATIONS OF THE ORION NEBULA AND NGC 2024. Soifer, B.T.; Hudson, H.S. (Department of Physics, University of California, San Diego). Astrophys. J. Lett. 191: No. 2, L83-L86 (15 July 1974).

We report here new observations at submillimeter wavelengths (~400 μ) of the Orion Nebula and NGC 2024. These observations provide a fairly detailed (FWHM ~1′.6) map of the Orion Nebula at these wavelengths. We attribute the Orion Nebula emission to optically thin thermal radiation from dust grains in the molecular cloud with peak emission centered on the KL source. A comparison of our data with those of Harvey et al. at longer wavelengths shows that the emissivity must vary at $\nu^{2.0 \pm 0.5}$. We find evidence that the dust temperature varies with position, with the center having the higher temperature. If optical constants determined from lunar silicate material are used, then 0.05—0.10 g cm^{-2} of small particles would be required to produce the observed submillimeter emission, but this suggests a far larger mass ($\sim 5 \times 10^3$ $M_\odot$ in the central 1′.6) in the Orion molecular cloud than is normally assumed. Alternatively, the data require an opacity at 100 μ greatly exceeding that of the lunar silicates. (auth)

27907 MAGNETIC FIELDS IN THE ORION MOLECULAR CLOUD FROM THE ZEEMAN EFFECT IN SO. Clark, F.O.; Johnson, D.R. (National Bureau of Standards, Washington, D.C.). Astrophys. J. Lett. 191: No. 2, L87-L91 (15 July 1974).

Reported line widths of observed emission features from a variety of interstellar molecules are compared for the Orion A molecular cloud. All of the excess width observed for SO in Orion A is assumed to be due to Zeeman splitting of the energy levels in order to obtain an estimate of the upper limit for the ambient magnetic field in this source. From the available data, upper limit estimates yield a most probable value near 6 gauss for the magnetic field in the central feature of Orion A. This estimate can possibly be reduced by a factor of 2 or 3 if other effects such as kinematics are responsible for a portion of the observed widths. The implications of a field of this magnitude in a dense molecular cloud are discussed. (auth)

27908 INTERPRETATION OF REDSHIFTS OF GALAXIES IN CLUSTERS. Harrison, E.R. (Department of Physics and Astronomy, University of Massachusetts, Amherst). Astrophys. J. Lett. 191: No. 2, L51-L52 (15 July 1974).

Radial (line of sight) velocities of galaxies are frequently expressed in the form $V=cz$ and interpreted to mean: $V=-v_O+V_G+cz_R$, where v_O is the radial component of our own peculiar velocity, V_G is the radial component of the peculiar velocity of the galaxy, and z_R is the cosmological redshift. When velocities are expressed in this fashion, it is important to note that the radial component of the peculiar velocity of the galaxy is not V_G but $v_G=(V_G+z_Rv_O)/(1+z_R)$. This correction is of first order in the cosmological redshift. The virial-theorem mass M_{VT} of a cluster of galaxies, calculated by using the catalogued dispersions $\langle V_G^2\rangle^{1/2}$, must therefore be reduced to $M_{VT}=M_{VT}'/(1+z_R)^2$ when v_O is negligibly small. (auth)

27909 STATISTICAL ANALYSIS OF CATALOGS OF EXTRAGALACTIC OBJECTS. III. THE SHANE-WIRTANEN AND ZWICKY CATALOGS. Peebles, P.J.E. (Joseph Henry Laboratories, Physics Department, Princeton University); Hauser, M.G. Astrophys. J. Suppl. Ser. 28: No. 253, 19-36 (June 1974).

We present a statistical investigation of clustering in the galaxy catalogs compiled by Zwicky et al. and by Shane and Wirtanen. We estimate the covariance and power spectrum of the angular distributions. We find that the region of space surveyed in the Zwicky Catalog acts like a "fair sample of the Universe," in sense that the statistical nature of the clustering revealed by this catalog is found mirrored at smaller angular scales in the deeper survey of Shane and Wirtanen. We find that the spatial correlation of galaxies as mapped in these surveys is quite small for separations greater than about $20h^{-1}$ Mpc ($h=$ Hubble's constant in units of 100 km s^{-1} Mpc^{-1}). Although this estimate is uncertain because of the uncertainty in the galaxy luminosity function, the correlation length for galaxies seems to fall clearly below the corresponding quantity for the distribution of the rich clusters of galaxies. (auth)

27910 STATISTICAL ANALYSIS OF CATALOGS OF EXTRAGALACTIC OBJECTS. IV. CROSS-CORRELATION OF THE ABELL AND SHANE-WIRTANEN CATALOGS. Peebles, P.J.E. (Joseph Henry Laboratories, Physics Department, Princeton University). Astrophys. J. Suppl. Ser. 28: No. 253, 37-50 (June 1974).

The cross-correlation between the galaxy counts compiled by Shane and Wirtanen and the angular positions of the rich clusters listed by Abell gives a powerful statistical measure on how galaxies are distributed around the rich clusters, and on how the galaxies counted by Shane and Wirtanen are distributed in distance from us. The correlation between clusters and galaxy counts is detected for clusters as distant as those in Abell's distance class 5, and over angular separations as large as 5°. The observations can be fitted by a cloud (supercluster) model, with ~2 rich clusters per cloud, and ~25 percent of all bright galaxies members of clouds. The clusters in Abell's richness class $R\geq 3$ are distinguished mainly by the fact that the long-range correlation with the galaxy counts is weaker than the correlation found for the clusters in richness classes 1 and 2. (auth)

27911 THE DWARF SPHEROIDAL COMPANIONS TO THE ANDROMEDA NEBULA. van den Bergh, S. (David Dunlap Observatory, University of Toronto, Richmond Hill, Ontario, Canada). Astrophys. J. 191: No. 1, 271-272 (1 July 1974).

All three of the dwarf spheroidal companions to the Andromeda Nebula have been resolved with the Hale telescope. Resolution occurs at approximately the same magnitude level as it does in NGC 185. Furthermore, a search in a 700 square degree area shows that these dwarfs are concentrated toward M31. These observations strengthen the conclusion that these objects are members of the Andromeda subgroup of the Local Group. (auth)

27912 RADIATIVE RELAXATION OF HYPERFINE POPULATIONS. Kwan, J. (Institute for Advanced Study, Princeton, New Jersey). Astrophys. J. 191: No. 1, 101-103 (1 July 1974).

The line radiation coupling two energy states produces a relaxation of hyperfine populations of each of the two states. This relaxation is effective if the hyperfine splittings are smaller than the thermal Doppler width of the line and if the stimulated radiative rates are high. Consideration of the relaxation of hyperfine populations among masing states can provide insight into the pump mechanisms. Among the four detected OH maser transitions at 18, 6.3, 5, and 2.2 cm, this relaxation process affects only the 2.2-cm transition if far-infrared lines alone are involved, but may affect all four maser transitions if near-infrared lines are also important. For H_2CO, it found that Dieter's previously proposed suggestion of nonequilibrium hyperfine populations is unlikely to be correct when radiative relaxation is included. (auth)

27913 IONIZATION MECHANISMS OF THE INTERCLOUD MEDIUM. Mészáros, P. (Princeton University Observatory). Astrophys. J. 191: No. 1, 79-88 (1 July 1974).

A generalized treatment of the ionization equilibrium of the intercloud medium is developed, which is model-independent in the steady-state approximation, and which is suited to an interpretation of ultraviolet absorption data. It is found that most satisfactory models require the presence of density inhomogeneities along the line of sight. In all models considered for λ Sco, 2-MeV cosmic rays and X-rays are found to lead to large disagreements with the observations, and data on ν Sco, α Leo, and other stars seem to support this conclusion. Therefore, it would seem that these cannot be the physical agents responsible for the bulk of the ionization of the gas; and we develop an alternative model, where the ionization below 24.58 eV is provided by ultraviolet photons. This model appears to satisfy theoretical requirements, and leads to good agreement with the data. (auth)

27914 UPPER LIMITS TO THE FLUX OF COSMIC RAYS AND X-RAYS IN INTERSTELLAR CLOUDS. O'Donnell, E.J.; Watson, W.D. (University of Illinois, Urbana). Astrophys. J. 191: No. 1, 89-92 (1 July 1974).

Upper limits for the rate of ionization per H atom ξ in interstellar clouds are deduced from molecular HD, (D/H), and other observations by the Copernicus satellite. For nine of 10 clouds that have been observed, $\xi\lesssim 10^{-16}$ s^{-1} is indicated and for some $\xi\lesssim 10^{-17}$ s^{-1}. Thus, the ionizing agent for the intercloud gas does not generally penetrate clouds. Proton densities are deduced. The efficiency of formation for H_2 on grains is estimated to order-of-magnitude accuracy and agrees with theoretical predictions. (auth)

27915 SUPERGIANT GALAXIES WITH MULTIPLE NUCLEI. Jenner, D.C. (Washburn Observatory, University of Wisconsin, Madison). Astrophys. J. 191: No. 1, 55-59 (1 July 1974).

The supergiant galaxies exhibit frequent multiplicity of nuclei within their extended envelopes. Observations of redshifts, angular separations, and relative radial velocities provide data for a sample of 10 galaxies with double nuclei. Analysis of the sample using the statistical method of Holmberg and Page yields a mean mass per nuclear component of $1.1(\pm 0.7)\times 10^{12}$ $M_\odot$ for a Hubble constant of 50 km s^{-1} Mpc^{-1}. (auth)

27916 THE NATURE OF HOAG'S OBJECT. O'Connell, R.W.; Scargle, J.D. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz); Sargent, W.L.W. Astrophys. J. 191: No. 1, 61-62 (1 July 1974).

Hoag's object is found to be a distant compact galaxy, 5 kpc in diameter, surrounded by a luminous blue ring with outer diameter 37 kpc. The absolute magnitudes of the core and ring are $M_v=-20.1$ and $M_v\sim -21$, respectively. Absorption by a dust band surrounding the core is not responsible for the appearance of the ring, which is an independent structural component of the galaxy. Several interpretations are considered, including the possibility that the system is a gravitational lens. (auth)

27917 A PRELIMINARY PHOTOELECTRIC SEQUENCE IN THE GALAXY M33 OF THE LOCAL GROUP. Sandage, A. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology); Johnson, H.L. Astrophys. J. 191: No. 1, 63-65 (1 July 1974).

Forty-seven stars in two areas of the nearby galaxy M33 were measured photoelectrically between 1954 and 1959 using the Mount Wilson and Palomar reflectors. The sequence ranges from $8.0\leq V\leq 21.3$, $8.9\leq B\leq 21.5$ and has been photographically smoothed fainter than $V\simeq 17.5$ by Dixon from measurements of eight 5-meter Hale reflector plates. The sequence, while not definitive, is sufficiently accurate for future work on the stellar content of this highly resolved galaxy. The galactic foreground reddening lies in the range $0.02\leq E(B-V)\leq 0.09$. Eight likely members of M33 are among the sequence stars. (auth)

27918 BEAM MASER MEASUREMENTS OF CH_3OH ROTATIONAL TRANSITIONS. Gaines, L. (Columbia Radiation Laboratory, Department of Physics, Columbia University); Casleton, K.H.; Kukolich, S.G. Astrophys. J. Lett. 191: No. 2, L99-L100 (15 July 1974).

Precise measurements of $K=2\rightarrow 1$ rotational transitions in CH_3OH were made using beam maser spectrometers at Columbia and MIT. $\Delta J=0$ transitions were observed in E-type states with $J=2,4,5,6,7$, and 8. No hyperfine structure was resolved at a resonance line width of 8 kHz (full width at half-maximum). Accurate center frequencies for these transitions are useful for determining Doppler shifts for observed interstellar lines. (auth)

27919 VARIATION OF THE GALACTIC FORCE LAW IN THE REGION OF THE SUN. Abhyankar, K. D. (Osmania Univ., Hyderabad, India). Pramana; 2: No. 6, 336-340(Jun 1974).

From the radial velocity data for O–B5 stars within 3 kpc of the sun the variation of the semi-axes Σ_1 and Σ_2 of the velocity ellipsoid in the solar region is estimated. It is found that both the semi-axes as well as their ratio Σ_2/Σ_1 decrease away from the galactic center. The value of Σ_2/Σ_1 changes from 1.17 at R = 9 kpc to 0.48 at R = 11 kpc passing through a value of 0.86 at the solar distance of R_0 = 10 kpc. These results are consistent with the usually assumed inverse square law of force in the outer regions of the galaxy. (auth)

27920 APERTURE SYNTHESIS OBSERVATIONS OF OH ABSORPTION IN THE GALACTIC CENTER. Bieging, J. H. Pasadena, CA; California Inst. of Tech. (1974). 187p. University Microfilms Order No. 74-17,938.

Thesis (Ph. D.).

The galactic center radio sources Sgr A and Sgr B2 were mapped, by an aperture synthesis technique, in the 1667 MHz absorption line of the OH molecule. The angular resolution of the maps is 3.25', and the velocity resolution is 1.44 km s^{-1}. The range of velocities covered by the maps is from −200 to +100 km s^{-1} in the local standard of rest. The data are presented in two forms: spectra of brightness temperature as a function of velocity, for fixed positions in right ascension and declination; and maps of the optical depth distribution in the spatial coordinates, for fixed velocity. The deep absorption line at +40 km s^{-1} in Sgr A is produced by two separate components. Both components appear to be very massive, dense clouds undergoing rapid rotation about axes perpendicular to the galactic plane. If the clouds are gravitationally bound, then their total masses must exceed $4.6 \times 10^6 M_\odot$ and $2 \times 10^5 M_\odot$. Fifteen discrete molecular clouds are seen in absorption against Sgr B2 over a velocity range from −120 km s^{-1} to +100 km s^{-1}. The strong absorption feature at +60 km/s^{-1} is resolved into four separate clouds, which are closely associated with the HII region GO.7-0.0. It is suggested that the ionized gas and the dense molecular clouds may be interacting dynamically to produce the observed difference in velocity between the H109α recombination line and the OH absorption lines. The implications of these observations for various kinematical models of the galactic center are discussed. Simple models with one or two expanding and rotating rings are not adequate to explain the data. The excitation temperature of the OH 1667 MHz transition is less than 10K, based on the maximum line temperature away from the continuum sources. However, one anomalous region north of GO.7-0.0 shows apparently thermal line emission, which implies an excitation temperature between 30 K and 80 K if the gas is optically thick. The thermal emission has a maximum angular extent of 12 arcminutes. The molecular clouds fall into two groups. Those with positive radial velocities have linewidths which are, on the average, twice as large as those for clouds with negative radial velocities. The positive-velocity clouds tend to have larger optical depths and column densities of OH. The mean value of N_{OH}/T_x for the positive-velocity clouds is 1.6×10^{15} cm^{-2} K^{-1}, while for negative-velocity clouds, the mean is 4.4×10^{15} cm^{-2} K^{-1}. For an assumed excitation temperature of 10 K, the space densities of OH molecules exceed by at least an order of magnitude the expected densities based on a theoretical model for the reaction rates of molecule formation. The parameters of the theoretical model may be inappropriate for the galactic center region. (Diss. Abstr. Int., B)

27921 SYSTEMATIC PROPERTIES OF CLUSTERS OF GALAXIES. Oemler, A. Jr. Pasadena, CA; California Inst. of Tech. (1973). 91p. University Microfilms Order No. 74-17,951.

Thesis (Ph. D.).

Fifteen rich clusters of galaxies were studied on photoelectrically calibrated photographic plates. These plates were measured using new automatic photometry techniques. Data in the literature were supplemented by new observations to obtain velocity dispersions in nine of these clusters. Clusters can be divided by their galaxy content into three types: spiral rich, spiral poor, and those dominated by a cD galaxy. The luminosity functions of the latter two types are very similar and differ significantly from that of galaxies in spiral rich clusters. The surface brightness profiles of the spiral poor and cD clusters agree in several respects with numerical models of collapsed clusters by Aarseth, but the spiral poor clusters are too irregular and have too little central concentration to be collapsed. All of the clusters have a local minimum in their profiles which cannot be explained. Spiral rich clusters tend to be less dense than average and cD clusters more dense, but, in the mean, all clusters follow a constant density law independent of mass. The cD clusters and others with a high ratio of elliptical to spiral galaxies have mass to light ratios of about 225, while the mass to light ratio of spiral rich clusters is less than half of this value. The collapse times calculated using these mass-luminosity ratios confirm that spiral rich clusters are still collapsing while the others are close to equilibrium. The degree of mass segregation in the collapsed clusters is close to that predicted by the Aarseth models and requires that most of the cluster mass be in the galaxies themselves rather than in a cluster-wide medium. The decrease of the number of spirals towards the center of the collapsed clusters supports the idea that SO galaxies are created by stripping the gas from spirals, and the spiral rich clusters can be expected to evolve into spiral poor clusters after collapse by this mechanism. The high proportion of elliptical galaxies in the cD clusters probably means that they are a distinct type of object, and not just a later evolutionary state of the spiral poor clusters. (Diss. Abstr. Int., B)

Cosmology

Refer also to abstracts 27630 and 28610.

27922 STEPS TOWARD THE HUBBLE CONSTANT. I. CALIBRATION OF THE LINEAR SIZES OF EXTRAGALACTIC H II REGIONS. Sandage, A.; Tammann, G.A. (Hale Observatories, Carnegie Institution of Washington, California Institute of Technology). Astrophys. J. 190: No. 3, 525-538 (15 June 1974).

Measurements of the angular sizes of the core and halo parts of H II regions are given for 11 galaxies in the Local and M81–NGC 2403 groups whose distances are known from Cepheid variables. Corrections for dependences on the experimental conditions are made by precepts developed in the Appendix. The apparent angular sizes are only weakly dependent on exposure time of the plates, showing that the measured sizes are defined essentially by conditions in the nebulae rather than by the observational techniques. The linear dimensions of H II regions in the calibrating galaxies and in six galaxies of the M101 group [with $(m-M)_0$=29.3 from Paper III of this series] increase steeply with the luminosity of the parent galaxies at a rate $\Delta \log D/\Delta M_{pg} = -0.14$. This is close enough to the distance–independent value of −0.2 that straight–forward use of H II diameters as distance indicators is impossible. Because of this $D=f(M_{pg})$ dependence, nearby dwarf galaxies have nearly the same angular size for their H II regions as distant giant Sc galaxies of the same apparent magnitude. To circumvent the difficulty, we have calibrated the linear diameters versus the luminosity class of the parent galaxy. The final correlation is tight, giving a 1–sigma spread of σ (ΔD/D) =0.06 (6 percent) for the first–ranked halo diameters in Sc I galaxies, increasing to σ (ΔD/D) =0.24 for luminosity class V Ir systems. The mean size of the largest H II region (core plus halo diameters) is 550 pc for Sc I galaxies, decreasing to 110 pc for luminosity class V galaxies. This is the first of a series of papers on successive steps for measurement of the Hubble expansion rate. This calibration of H II regions forms the basis for distances to general field galaxies (Paper IV), which itself is an intermediate step for distances to Sc I galaxies that are distant enough ($cz \geq 4000$ km s^{-1}) to permit reliable determination of the Hubble constant (Papers V and VI). (auth)

27923 COSMIC BACKGROUND RADIATION AT 1.32 MILLIMETERS. Hegyi, D.J. (Bartol Research Foundation of the Franklin Institute, Swarthmore, Pennsylvania 19081); Traub, W.A.; Carleton, N.P. Astrophys. J. 190: No. 3, 543-544 (15 June 1974).

We have remeasured the R(2) line of the 3874 Å band of interstellar CN toward ζ Oph and find an equivalent width of 0.120 ± 0.074 mÅ, which implies an R(2)–R(1) rotational temperature of 3.1° (+0.5°,−0.7°)K. Summing these observations with our earlier spectrum and refitting the summation, we find the R(2) equivalent width to be 0.089±0.051 mÅ, which implies a temperature of 2.9° (+0.4°,−0.5°)K for the cosmic background radiation at 1.32 mm. (auth)

27924 DEATH OF WHITE HOLES IN THE EARLY UNIVERSE. Eardley, D.M. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. Lett. 33: No. 7, 442-444 (12 Aug 1974).

A white hole (a compact, long–delayed region of the big bang) cannot exist, because if suffers an exponentially growing instability that converts it into a black hole. Such instabilities might have homogenized the early universe. (auth)

27925 CONSTRAINTS ON THE X–RAY BACKGROUND SPECTRUM IN THE INVERSE–COMPTON MODEL. Prilutskii, O.F. (Institute for Space Research, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 6, 833-833 (May 1974).

The spectral index of background x rays generated by the inverse Compton effect through interactions with background radiation in intergalactic space should satisfy the criterion $\gamma_\gamma \geq 3/2$. (auth)

27926 GRAVITATIONAL FOCUSING. Ingel', L.K. Sov. Astron.—AJ 17: No. 6, 836-836 (May 1974).

Attention is called to the high-quality lens properties that the internal gravitational field of a massive spherically symmetric body (such as a star) would present to gravitational radiation (or neutrinos), under very general assumptions regarding the radial density distribution. This circumstance might, for example, offer prospects for interstellar communication. (auth)

27927 ISOTROPIZATION OF COSMOLOGICAL EXPANSION DUE TO PARTICLE PRODUCTION. Lukash, V. N.; Starobinskii, A. A. (Moscow Physical-Technical Inst.). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1515-1527(May 1974). (In Russian).

The problem is considered of isotropization occurring during cosmological expansion of a homogeneous universe with a flat comoving space (model I Bianci type) under the action of gravitation of particles produced spontaneously near an anisotropic Casner singularity. Interaction between the newly created particles is taken into account. The reverse effect of particles created near the singularity on the metric leads to a rapid isotropization of cosmological expansion. Restrictions on the time of isotropization based on observations of isotropy of the relic background are presented. (auth)

27928 COSMOCHEMISTRY. Boschke, F. (ed.). Topics Current Chemistry, 44. New York; Springer-Verlag (1974). 180p.

Four papers are presented which represent critical reviews of the present position and future trends in modern chemical research. Separate abstracts are prepared for two pages. The two papers not abstracted deal with carbon chemistry of the Apollo lunar samples and advances in inorganic geochemistry. (LBS)

For abstracts of individual papers see: 27790 and 27938.

27929 COSMIC DUST AND ITS FUNCTION IN THE FORMATION OF STARS. Dorschner, J. (Univ., Jena, Ger.). Jena Rev.; 6: 323-330(1973).

Essential observed facts on interstellar and circumstellar dust are dealt with, whereupon the most important hypotheses on the origin and chemism of the dust particles are discussed. The cosmogonic role of the cosmic dust is touched on. Primary emphasis is on progress made in the last year in the exploration of the circumstellar dust. (MHR)

27930 FINE-SCALE TEMPERATURE VARIATIONS IN THE 11.1-CM COSMIC BACKGROUND RADIATION. Stankevich, K.S. (Gor'kii Radiophysics Institute). Sov. Astron.—AJ 18: No. 1, 126-127 (July 1974).

Measurements with the 64-m Parkes radio telescope of fine-scale space variations in the cosmic background radiation at 11.1-cm wavelength are reported. The temperature fluctuations on an angular scale in the range $8' < \theta < 19'$ are approximately $4.2 \cdot 10^{-4}$ °K. (auth)

27931 DYNAMICAL ANALYSIS OF BRANS-DICKE COSMOLOGIES. Morganstern, R.E. (Physical Sciences Department, Florida International University, Miami). Astrophys. J. 191: No. 1, 39-41 (1 July 1974).

Relations amoung the dynamical observables at the present epoch are found by algebraically solving the Brans-Dicke (BD) cosmological field equations. These relations display most of the quantitative upper bounds and other features established by means of the exact cosmological solutions given by Brans and Dicke and the present author. Moreover, the results of the present analysis depend upon the existence of an equation of state $p=p(\rho)$ but not on its particular form. Finally, the relation between Dicke's various types of solutions and the general solution of the author are clarified by this analysis. (auth)

27932 ARE BL LAC-TYPE OBJECTS NEARBY BLACK HOLES. Shapiro, S. L.; Elliot, J. L. (Cornell Univ., Ithaca, NY). Nature (London); 250: No. 5462, 111-113(12 Jul 1974).

It is stated that isolated black holes accreting interstellar gas can account for the salient properties of the BL Lac-type objects. The observed frequency spectra in the visible and infrared, and rapid variations in intensity and polarization, and the absence of discrete features in the optical spectra are all consequences of the adopted black hole accretion model. (auth)

27933 CATASTROPHES IN AN EXPANDING UNIVERSE. Castagnino, M. (Buenos Aires Univ. Nacional (Argentina)); Verbeure, A.; Weder, R. (Louvain Univ. (Belgium)). Phys. Lett., A; 48: No. 2, 99-100(3 Jun 1974).

Using Parker's method for the quantization of a massless real scalar field in an expanding universe, it is proved for a Friedman-like model that the time evolution is not implementable in four dimensions, yielding some pathological behaviour of the total number of particles operator. This is not present in the two-dimensional model. (auth)

27934 COMMENTS ON TWO RECENT MEASUREMENTS OF THE SOLAR GRAVITATIONAL RED-SHIFT. Snider, J. L. (Oberlin Coll., Ohio (USA)). Solar Phys.; 36: No. 1, 233-234 (May 1974).

Two years ago the experimental confirmation at Oberlin College of the Einstein gravitational red-shift of the solar potassium line at 7699 Å was reported (Snider, 1972). An earlier version of the experiment, reported in 1970 in this journal, did not find the full predicted red-shift (Snider, 1970). This note presents the explanation, only discovered during the second experiment, as to why the originally measured value was low, and makes several additional comments on the final result. (NL)

Planetary Phenomena

Refer also to abstract 27703.

27935 THE OCCULTATION OF BETA SCORPII BY JUPITER. II. THE HYDROGEN-HELIUM ABUNDANCE IN THE JOVIAN ATMOSPHERE. Elliot, J.L.; Wasserman, L.H.; Veverka, J.; Sagan, C. (Laboratory for Planetary Studies, Cornell University, Ithaca, New York 14850); Liller, W. Astrophys. J. 190: No. 3, 719-729 (15 June 1974).

The helium abundance in the Jovian atmosphere has been determined by a new method from our observations of the occultation of β Scorpii by Jupiter. The occultation light curves, consisting of simultaneous records at three wavelengths with a time resolution of 0.01 s, are dominated by sharp, well-defined intensity peaks or spikes. Because of the wavelength-dependence of the refractivity of the Jovian atmosphere, the arrival time of a given spike at the Earth is also wavelength dependent. A new method for determining the composition of a hydrogen-helium atmosphere from such data is presented, and the principal sources of error are discussed and evaluated. The derived helium fraction is f(He) $=0.16(+0.19,-0.16)$ by number, and probably applies to a region below the turbopause, where the atmosphere is well mixed. In this case, a Jovian atmosphere composed mainly of helium can be ruled out. Our derived helium fraction is consistent with the solar abundance [f(He) $\simeq 0.10$]. (auth)

27936 INVERSE MULTIPLE SCATTERING PROBLEMS. II. Limited Information Content of Partially Fitted Planetary Curves with Application to the Venusian Visual Phase Curve. Fymat, A. L. (California Inst. of Tech., Pasadena); Kalaba, R. E. J. Quant. Spectrosc. Radiative Transfer; 14: No. 9, 919-933(Sep 1974).

The random grid search method and the minimization search method recently developed by Fymat (Proc. 1972 Intern. Radiation Sympos., Sendai, Japan, p. 243, paper I (1973)) for solving inverse multiple-scattering problems of planetary atmospheres are employed for a study of the extent and nature of true information yielded by theoretical partial fits of observed planetary curves. The study is conducted with the Venusian visual phase curve as a background example. It is shown that such fits cannot be used to infer the model scattering parameters of the planet's atmosphere. They cannot provide any indication of the shape of the scattering diagram, even in the region of the fit. It is also shown that the measured Bond albedo can provide neither a criterion for sorting out different possible scattering model candidates nor a means for accurately determining the single scattering albedo. A high value of the latter albedo for Venus' atmosphere at visible wavelengths ($\tilde{\omega}_0 \approx 0.99$) is also found, and Euler's scattering model is definitely discarded for this planet. (auth)

27937 SILICATE MINERAL CHEMISTRY OF SELECTED APOLLO 15, 16, AND 17 SOILS. Taylor, H. C. Dallas; Univ. of Texas (1973). 285p. University Microfilms Order No. 74-18,749.

Thesis (Ph. D.).

The utilization of small amounts of material in the mineralogical and chemical characterization of lunar soil samples appears to be very successful in formulating major geological deductions. Such knowledge should be valuable in the planning of future extraterrestrial scientific missions. Mineral analyses of pyroxenes, olivines and plagioclases from the less than 1 millimeter fraction of some Apollo 15, 16, and 17 soil samples can be used to distinguish mare, KREEP and ANT or highland basalt components in these soils. Comparison of mineral chemistry in soils 15501 and 15411 from the Apennine Front/Hadley Rille area allow characterization of the 15501 soil collected near Hadley Rille as consisting primarily of mare-basalt components, whereas the 15411 soil, collected at Spur Crater on the Hadley Delta front, consists primarily of gabbroic-anorthosite components. Contamination of the 15501 mare-basalt soil with minor amounts of the gabbroic-anorthosite component may indicate the effect of downslope mass wasting of materials from the Apennine Front onto the mare surface. Apollo 16 soil 66081 from the Descartes area has only an ANT component, whereas soil 69941 from South Ray Crater has a major ANT component together with a possible minor KREEP and ultramafic component. The possible

ultramafic component consists of olivine as forsteritic as $Fo_{94.5}$ and by Mg-orthopyroxene with values as high as $En_{87.3}$. Apollo 17 soil 75081 from the Taurus-Littrow region is primarily composed of a mineral constituency similar to that of a pyroxene-bearing ilmenite basalt; a major rock type previously described as making up a large portion of the sub-floor material of the valley fill within the region. This characterization of soil 75081, which is thought to be a sample of the dark-mantling material covering much of the surface of the Taurus-Littrow region, may therefore help to establish a genetic relation between the dark-mantle and the sub-floor geological units. Gray soil 74241 and orange soil 74220, thought to be ejecta from Shorty Crater, contain a major mineralogical constituency similar to the ANT suite of highland rocks. The occurrence of Shorty Crater on the bright mantle deposit, a geological unit thought to consist of avalanche debris from the south massif, helps establish the lithological character of the south massif in the Taurus-Littrow area. Orange glass spherules and fragments, composing about 95 percent of soil 74220, appear to have been produced, not by impact melting of rock or regolith material, but by the cooling of a homogeneous, essentially crystal-free melt during which the formation of the barred-olivine spinifex textures occurred. (Diss. Abstr. Int., B)

27938 CHEMISTRY OF THE MOON. Waenke, H. (Max-Planck-Institut fuer Chemie, Mainz). pp 115-154 of Cosmochemistry. Boschke, F. (ed.). New York; Springer-Verlag (1974).

The topics discussed include: the chemistry of the lunar samples; the europium anomaly; solar wind implantation; meteoritic component; formation of the lunar landscape, element correlations; condensation sequence of the planetary nebula, composition and structure of the moon, and origin of the moon. (LBS)

27939 WAS JUPITER THE PROTOSUN'S CORE. Dorbyshevski, E. M. (Physical-Technical Inst., Leningrad). Nature (London); 250: No. 5461, 35-36(5 Jul 1974).

The idea that jupiter and the sun might be regarded as a binary system is discussed, and it is suggested that in the early stages of the development of the system jupiter may have been the dominant partner, and may originally have formed the core of the protosun. Lower mass components in many binary star systems have been found to be more highly evolved than their more massive components, and this is explained in terms of mass exchange between the components; this is how the evolution of the early solar system is explained, including the formation of the other planets, which could be a by-product of the evolution of the jupiter–sun system. (UK)

27940 SCATTERING AND HELIOCENTRIC DISTRIBUTION OF ZODIAC PARTICLES. Dumont, R. (Observatoire de Bordeaux, Floirac, France). Compt. Rend., Ser. B; 278: No. 12, 537-540(18 Mar 1974). (In French).

Interplanetary particles isotropically scatter solar light when the electric vector is normal to the scattering plane. When this vector is at right angles to the scattering plane, a large amount of polarization occurs. The existence of ellipsoidal cloud in which r^{-1} and r^{-3} particle distributions exist in the mean plane of the planets has been postulated. This flattened cloud (a/b ratio approximately equal to 8) would explain the photopolarimetric parameters of zodiac light. (FR)

27941 REALISTIC MODELS OF THE GIANT PLANETS. Podolak, M. New York; Yeshiva University (1974). 137p. University Microfilms Order No. 74-16,443.

Thesis (Ph. D.).

Models of the giant planets were constructed based on an accumulation picture of planetary formation. This picture predicts a core of rock, surrounded by a mixture of hydrogen, helium, water, ammonia, and methane. These last three volatiles may be enhanced above the solar ratio due to condensation from the primitive solar nebula. Jupiter was found to have a core of about 40 earth masses, and a water enhancement of about 7.5 times the solar value. For Saturn two types of models were computed. One type of model had a core of rock like the Jupiter models, while the other type consisted of a rocky core surrounded by an ice layer. In both cases the core (rock or rock + ice) had a mass of about 20 earth masses, while the water in the atmosphere was enhanced to about 25 times the solar value. The results for Uranus and Neptune are open to question, because of the uncertainties in the rates of rotation of these planets, and the values of the higher order moments of the gravitational fields. The calculations indicate, however, that the ratios of water to hydrogen and ammonia to hydrogen are significantly above the solar values, while for Neptune the ratio of methane to hydrogen is also much higher than the solar value. This is in accord with the expected condensation sequence in the primitive solar nebula. The agreement of these models with the observed data (mass, radius, higher moments of the gravitational field, and surface temperatures) is discussed. (Diss. Abstr. Int., B)

27942 WATER AND CARBON IN RUSTY LUNAR ROCK 66095. Friedman, I.; Hardcastle, K. G.; Gleason, J. D. (Geology Survey, Denver). Science; 185: No. 4148, 346-349(26 Jul 1974).

Lunar rock 66095 contains a hydrated iron oxide and has an unusual amount of water for a lunar rock (140 to 750 parts per million), 90 percent of which is released below 690°C. The δD of water released at these low temperatures varies from −75 to −140 per mil relative to standard mean ocean water (SMOW). The small amount of water released between 690° and 1300°C has a δD of about -175 ± 25 per mil SMOW. These δD values are not unusual for terrestrial water. The $\delta^{18}O$ of water extracted from 110° to 400°C has a value of $+5 \pm 1$ per mil SMOW, similar to the value for lunar silicates from rock 66095 and different from the value of −4 to −22 per mil found for samples of terrestrial rust including samples of rusted meteoritic iron. The amount of carbon varies from 11 to 59 parts per million with a $\delta^{13}C$ from −20 to −30 per mil relative to Pee Dee belemnite. Only very small amounts of reduced species (such as hydrogen, carbon monoxide, and methane) were found, in contrast to the analyses of other lunar rocks. Although it is possible that most of the water in the iron oxide (goethite) may be terrestrial in origin or may have exchanged with terrestrial water during sample return and handling, evidence presented herein suggests that this did not happen and that some lunar water may have a δD that is indistinguishable from that of terrestrial water. (auth)

27943 DIRECTIONAL VARIATION OF INTERPLANETARY L_α EMISSION FROM VENERA 6 DATA. Smirnov, A. S. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 6, 814-817(1973).

Translated from Kosm. Issled.; 11: No. 6, 903-906(1973).

The results of measurement of L_α emission in interplanetary space by the automatic interplanetary station Venera 6 are given. The measurements are consistent with a model of scattering of solar L_α emission by cold hydrogen in the interstellar wind with the additional hypothesis of an L_α radiation background which becomes more intense towards the plane of the galaxy. (auth)

27944 ELECTROMAGNETIC INDUCTION IN THE MOON. Van'yan, L. L.; Egorov, I. V. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 6, 823-834(1973).

Translated from Kosm. Issled.; 11: No. 6, 913-925(1973).

The electromagnetic induction of the moon is investigated, taking into account the void behind it, based on calculations undertaken by means of a computer. Certain principles are developed for the deep electromagnetic sounding of the moon. (auth)

27945 RADIOACTIVITY OF REGOLITH BROUGHT BACK FROM THE VICINITY OF THE APOLLONIUS-S CRATER BY THE LUNA 20 LUNAR PROBE. Surkov, Yu. A.; Fedoseev, G. A.; Sobornov, O. P.; Tarasov, L. S. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 6, 835-840(1973).

Translated from Kosm. Issled.; 11: No. 6, 926-932(1973).

The low-background gamma-spectrometry method was used to obtain data on the radioactivity of lunar soil brought back by Luna 20 from the continental region near the Apollonius-S crater. On the basis of the data obtained in this experiment and analyzed in combination with research carried out by other authors, deductions have been made concerning some peculiarities in the formation of regolith in this lunar region. On the basis of an analysis of the contents of natural radioactive elements in the lunar samples and their comparison with data on the radioactivity of basic and ultrabasic terrestrial rocks, assumptions have been made concerning the similarity of the primary material of the earth and that of the moon. (auth)

27946 IO-MODULATED JOVIAN DECAMETRIC RADIATION. Smith, R. A. College Park, MD; Univ. of Maryland (1973). 228p. University Microfilms Order No. 74-16,577.

Thesis (Ph. D.).

The emission and propagation of Io-induced decametric radio emission in the inner plasmasphere of Jupiter is considered. Very short-wavelength, quasi-electrostatic waves, with frequency near the local electron cyclotron frequency, are amplified by a collective plasma instability driven by the drift current associated with a steep density gradient of energetic particles at the walls of the flux tube threading Io; the density gradient is produced by the sweeping effect of Io, which is assumed to be only a moderately conducting body. The growth rate γ of the instability is in the range 10^{-3} sec$^{-1} < \gamma < 10^{-2}$ sec^{-1}, leading to several e-folding in intensity in a time comparable to 2×10^3 sec, the time delay necessary to account for the asymmetry of the Io phase with respect to sources east and west of the Earth-Jupiter line. During this time the waves have extremely low group velocities, of order 1-10 km sec^{-1}, and so remain in the source region. A semi-phenomenological model is offered for

the frequency drifts of the modulation lanes in the dynamic spectra, based on the effect of this low group velocity in the source region. The gradient drift current also amplifies low frequency turbulence which causes enhanced diffusion of energetic particles back into the swept region, reducing the density gradient and so turning off the instability at decametric frequencies. The time scale for elimination of the density gradient is a function of the local cyclotron frequency and increases as the frequency decreases; at low frequencies the decay time is so long that positional correlation of emission with Io may be quite poor, leading to the statistical interpretation of lower-frequency decametric emission as being partially dependent of Io. For the instabilities to occur, there exist minimum conditions on the density of thermal plasma in the source region; these conditions are compatible with a density model based on diffusive equilibrium with the ionosphere as an exobase. (Diss. Abstr. Int., B)

27947 SOME STUDIES OF THE JOVIAN UPPER ATMOSPHERE. Capone, L. A. Gainesville, FL; Univ. of Florida (1973). 156p. University Microfilms Order No. 74-10,032. Thesis (Ph. D.).

Some new results concerning the ionosphere formation in the Jovian upper atmosphere are reported with special reference to some of the recently available reaction rates, and also with reference to the recent models of the Jovian neutral atmosphere as given by Shimizu (1971). It has been found that the role of the radiative association of H^+ to H_2 to form H_3^+ is important, even with a reaction rate of 10^{-15} cm^3sec^{-1}. In the lower regions of the ionosphere, three-body processes leading to the formation of the heavier H_3^+ and H_5^+ ions which have very fast dissociative recombination rates, produce a large reduction in the electron density. When no radiative association takes place, and the H^+ ions are lost by pure radiative recombination alone, the photochemical equilibrium profile is also the diffusive equilibrium profile. However, with collisional-radiative recombination, whose rate becomes altitude dependent, diffusion tends to bring about some redistribution of the ionization. Inclusion of the radiative association enhances the role of diffusion. In this case, the diffusion brings about all the expected changes. In particular, the differences in the electron density profile, originated in the lower-middle ionosphere by the radiative association, are propagated up to all the higher altitudes by the diffusion. The rate constant of the radiative association is, however, unknown. It is hoped that the critical importance of this reaction in the Jovian ionosphere formation will be an incentive towards a careful laboratory determination of this rate coefficient. In the earlier published models of the Jovian ionosphere, the major ions were H^+ which were lost only by pure radiative recombination. This led to high electron densities and practically no diurnal change. In contrast, the new models presented here have relatively much smaller electron densities, especially in lower regions, and may be susceptible to significant diurnal variation. The photochemistry of methane and ammonia has been treated as rigorously as possible. The distribution of atomic hydrogen and products of methane and ammonia photolysis have been obtained. These distributions are representative of global average during solar minimum. It has been found that the catalytic action of NH_2^+, as first pointed out by McNesby (1969), could be of paramount importance, and produces a dramatic increase in the atomic hydrogen concentration. Through atomic hydrogen, other hydrocarbons are also affected by the role of NH_2^+, and a significant depression of their concentrations results. The distribution of ethane (C_2H_6) is subject to great uncertainty. Complete mixing represents one extreme. Other useful lower boundary conditions include that of "stationary" downward flux, or constant number density with altitude. Models for both these boundary conditions are shown in the presentation of the results. The solution of the time-dependent coupled continuity equations which describe the altitude distributions of these minor constituents is discussed. (Diss. Abstr. Int., B)

PHYSICS (ATMOSPHERIC)

27948 THUNDERCLOUD RADIO EMISSION FROM COSMIC–RAY–SHOWER IONIZATION ELECTRONS. Tompkins, D.R. Jr. (Department of Physics and Astronomy, University of Wyoming, Laramie, Wyoming 82070). Phys. Rev. D 10: No. 1, 136-145 (1 July 1974).

The drift of shower ionization electrons in thundercloud fields constitutes a traveling current pulse whose amplitude is modulated by shower development and by the thundercloud field. The radio emission from such a pulse is evaluated. To distinguish shower ionization radio pulses from random noise, the use of two receiver bands centered at a common frequency is proposed. It is shown that the ratio of the power in the two bands can be used to distinguish shower ionization radio signals from random noise. For modulated current pulses traveling above the speed of light in a medium, an inverse modulation effect is found. For unmodulated current pulses traveling above the speed of light in a medium, a new class of realizations of the Čerenkov effect is discovered. (auth)

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Refer also to abstracts 27798 and 27892.

27949 (AD-772713) OBSERVATIONS OF PRECIPITATING PROTONS WITH RING-CURRENT ENERGIES. Report for June 1972–June 1973. Mizera, P. F. (Aerospace Corp., El Segundo, Calif. (USA)). 23 Dec 1973. Contract F04701-73-C-0074. 36p. (SAMSO-TR-73-400). NTIS $3.25.

Precipitating protons with energies characteristic of the storm-time ring current were measured during all phases of magnetic activity near the low-altitude trapping boundary at midnight. The objective of this study was to examine the energy dependence of the precipitating fluxes as a function of latitude (or L shell) and relative to the plasmapause and the low-energy isotropic electron enhancements which are associated with the outer-zone boundary. The low-energy measurements, taken by the OV1-17 satellite, covered the time period from 19 March–3 April 1969. Data, provided by the OV1-19 spacecraft during the same time period, were used to extend the measurements to higher energies and to examine pitch-angle distributions. (GRA)

27950 (AD-773405) IONOSPHERIC MODEL FOR CURRENTS, THE ELECTRIC FIELD, AND THE PLASMA DENSITY IN AN AURORAL ARC. Fedder, J. A. (Naval Research Lab., Washington, D. C. (USA)). Jan 1974. 27p. (NRL-MR-2691). NTIS $3.25.

A model of an auroral arc is presented for the self consistent calculations of currents, the ionospheric electric field, and the plasma density. The results of model calculations are presented for a selection of assumed values of the magnetospheric electric field and an anomalous resistance to geomagnetic field-aligned currents. These calculated currents and electric fields are shown to be in qualitative agreement with the published measurements. (GRA)

27951 (AD-774149) THERMOSPHERE AND THE F-REGION: A RECONCILIATION OF THEORY WITH OBSERVATIONS. Stubbe, P. (Pennsylvania State Univ., University Park (USA). Ionosphere Research Lab.). 19 Jul 1973. Contract N00014-67-A-0385-0017. 162p. (PSU-IRL-SCI-418). NTIS $11.25.

Our present knowledge of the processes determining the F-region behavior is examined by performing detailed comparisons between theoretical and measured F-region quantities. Much of the work is devoted to adjusting the thermospheric composition and temperature as well as the neutral wind velocity. It is found that the seasonal composition changes have two main components—an annual component with a minimum and a semi-annual component with a maximum in the equatorial region. The exospheric temperature exhibits a much larger seasonal variation than indicated by present atmospheric models. The agreement between the required and theoretically obtained wind velocities is not always satisfactory, particularly at lower latitudes. Some of the relevant ion reaction rates as well as the heat input rate to the electron gas are examined. Some changes are suggested. Finally, all the modifications introduced in this work are tested by comparing the theoretical results with observations during the eclipse of March 7, 1970. (GRA)

27952 (AD-774550) HIGH ALTITUDE PLASMA EFFECTS. Final Report, 28 February 1972–31 December 1973. Arnush, B.; Fried, B. D.; Kennel, C. F.; Stenzel, R. L.; Wong, A. Y. (TRW Systems Group, Redondo Beach, Calif. (USA)). Dec 1973. Contract F30602-72-C-0304. 30p. (TRW-21961-6006; RADC-TR-74-23). NTIS $3.25.

The principal results of the program to simulate ionospheric modification field experiments in the QUIPS device are reviewed. By linear mode conversion electromagnetic waves (EMW) propagating in the inhomogeneous laboratory plasma produced very intense electron plasma waves (EPW) (orders of magnitude above the EMW) propagating along the density gradient. Unanticipated by conventional theory, the linearly converted EPW was the lowest threshold pump of the parametric instability. In square wave operation, at the turn-off and turn-on of the EMW pump, the ponderomotive force due to the electrostatic field of the linearly converted EPW produced a large pulse of density perturbation, proportional to incident power (i.e., without threshold), which propagated away from the plane of reflection of the EMW. (GRA)

27953 (AD-774986) MEASUREMENT OF RADIOTHERMAL AND PLASMA RADIATIONS IN THE SUPERHIGH-FREQUENCY RANGE. Basharinov, A. E.; Tuchkov, L. T.; Polyakov, B. M.; Ananov, N. I. 5 Mar 1974. Translation of Izmerenie Radioteplovykh i Plazmennykh Izluchenii v SVCh Diapazone, Moscow, 1968. (FSTC-HT-23-670-69). 428p. NTIS $28.50.

A systematic presentation is given of the results of studies of the generation and transfer of natural superhigh-frequency radiations and the reception of superhigh-frequency broad-band signals in relation to the problem involved in propagation of radio waves, geophysics, radiometeorology and plasma physics. In addition to a generalization of the studies made by the authors and their associates, systematically processed material is given on the theoretical and experimental studies published prior to the middle of 1966. The monograph consists of four parts giving physical concepts concerning the mechanism of superhigh-frequency radiations, the results of studies of the superhigh-frequency radiation of different types of ground cover, the atmosphere and plasma formations, and considers the problems involved in signal reception and selection. (GRA)

27954 (AD-775084) DETAILED SPECIFICATION OF THE ARCTIC IONOSPHERE AND AN APPLICATION TO THREE-DIMENSIONAL RAYTRACING. Air Force Surveys in Geophysics. Buchau, J.; Pike, C. P.; Wong, M. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 27 Nov 1973. 30p. (AFCRL-73-0726; AFCRL-SFSIG-279). NTIS $4.50.

A statistical analysis of Alouette topside ionograms shows that the probability of occurrence of the midlatitude F-layer trough is 100 percent in winter and at equinox, and is 50 percent in summer. The trough, which is generally centered on 55 degrees corrected geomagnetic latitude and which is about 5 degrees to 10 degrees wide, extends throughout the night hemisphere with f(o)F2 values less than 2 MHz. Comparison of the location of the trough to the area in which coverage by an over the horizon backscatter (OTHB) system is anticipated shows that the trough will adversely affect system performance in the northeast direction most of the night. An in-depth case study of the effects of the trough on HF propagation was made, based on an instantaneous three-dimensional description of the ionosphere. This description of the ionosphere was composed of cross sections showing ionospheric electron-density structure in the area northeast of the Polar Fox II site. Three-dimensional raytracing was applied to this description of the ionosphere, and the trough and the steep electron-density gradient at the poleward edge of the trough were found to adversely affect propagation of HF signals. (GRA)

27955 (AD-775088) ELECTRON TRANSPORT IN A DILUTE WEAKLY IONIZED GAS APPLICATION TO A MODEL IONOSPHERE. Jasperse, J. R. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 27 Sep 1973. 53p. (AFCRL-TR-73-0600; AFCRL-ERP-456). NTIS $5.75.

A kinetic model for the electron distribution function in microspace in a dilute, nonuniform, weakly ionized gas is presented. The model includes photoproduction of electron-ion pairs, electron-ion recombination, and elastic, inelastic, and ionizing electron-neutral collisions. Under special conditions exact solutions are found for the steady-state electron velocity spectrum in a uniform, infinite medium for a delta-function photon energy source, and for an exponentially decreasing photon energy source. Also presented is a general method for finding the electron distribution function in a plane-parallel medium where the neutral gas density varies exponentially with position. The method is applied to give an approximation to the electron-ion concentration, the electron-ion drift velocity, and the electron temperature for a model ionosphere at altitudes where the assumption of weak ionization is valid. (auth)

27956 (AD-775842/8) REACTION RATE DATA NUMBER 43. (General Electric Co., Santa Barbara, Calif. (USA)). Oct 1973. Contract DNA001-73-C-0019. 34p. NTIS $3.25.

The report contains abstracts of research in aeronomy and upper atmospheric chemical processes and reaction kinetics. Nuclear fireballs, gas ionization, plasmas, and spectra of atmospheric species are other topics covered. (GRA)

27957 (AD-776002/8) PLASMA SPECTROSCOPY OF NEGATIVE IONS FOR APPLICATIONS TO IONOSPHERIC RESEARCH. Final Report, 1 February 1969–31 August 1973. Cooper, J.; Slater, J. (Joint Inst. for Lab. Astrophysics, Boulder, Colo. (USA)). Dec 1973. 30p. (AFOSR-TR-0303). NTIS $4.50.

An experimental investigation is made of a singlet p resonance in H^- by means of photoabsorption spectra. The predicted resonance wavelength is 1129.5 A and a windowless vacuum uv apparatus which allows absorption studies on ionized species has been developed. Basic equipment is described. H^- densities are generated in the afterglow of the z-discharge through a mixture of hydrogen and cesium. The resonance was not observed, probably because of overlying 2-1 band lines of the H_2 lyman system which were more intense than originally predicted. However, the techniques developed in this work represent a significant contribution in that they for the first time allow time resolved absorption spectra on ionized species. (GRA)

27958 (AD-776238/8) E AND F-REGION CHEMISTRY AND HIGH-LATITUDE IONOSPHERE. Final Technical Report, 15 January 1972–31 December 1973. Hamlin, D. A.; Myers, B. F.; Schoonover, M. R.; Valerio, J. I. (Science Applications, Inc., La Jolla, Calif. (USA)). 28 Feb 1974. Contract N00014-72-C-0292. 116p. (SAI-74-537-LJ). NTIS $4.50.

The contents are: calculated and observed photoelectron-flux spectra at dawn; the effect of uncertainties in rate coefficients on densities of E-region species; ionospheric-electron heating by dissociative recombination; temperature dependence for dissociative recombination of NO^+ in E- and F-region models. (GRA)

27959 (AD-776241/2) IONOSPHERIC IRREGULARITIES: ALASKA PHOTOMETRIC MEASUREMENTS. Final Report, 1 December 1972–30 November 1973. Sears, R. D. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). 4 Dec 1973. Contract DNA001-73-C-0110. 78p. (LMSC-D-354546; DNA-3235-F). NTIS $7.00.

Photometric measurements of auroral intensities and structure were made in Alaska during 1972 and 1973. Photometric data supporting the ice cap '73A operations are presented in terms of definition of the energy input to the ionosphere in the spatial vicinity of the rocket borne in situ experiments. Coordinated analysis of spatial and temporal variations of auroral emission intensities and electron densities are outlined using both photometric intensity data and incoherent scatter radar data. Analysis of time variations of 4278A, 5875A, and 4861A emission intensities observed in 1972 indicates strong substorm time correlation with the intensity peaks, but no indication of He emission in the 5875A spectral region was found. An analytical method for converting F region 6300A, OI emission intensity structure maps into radar effects structure information was demonstrated for a low latitude region pertinent to radar scintillation effects measurements at Kwajalein missile range. (auth)

27960 (AD-776950) SURVEY OF TWO-BODY AND THREE-BODY REACTION-RATE COEFFICIENTS FOR THE IONIZED STRATOSPHERE AND MESOSPHERE. Niles, F. E. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Mar 1974. 107p. (BRL-1702). NTIS $4.50.

Rate coefficients for two-body and three-body reactions applicable to the ionized stratosphere and mesosphere were divided into five classes: (1) positive-ion reactions, (2) electron reactions, (3) negative-ion reactions, (4) ion-ion reactions, and (5) neutral reactions. Reactions and their measured rate coefficients are given in tables and the values selected for inclusion in the airchem atmospheric deionization computer code are identified. The current status of knowledge regarding these reactions is summarized. (GRA)

27961 (ANARE-TN-10) ASSOCIATION BETWEEN SOME FARADAY MEASUREMENTS AND AURORAL PARTICLE PRECIPITATION. Watkins, B. J. (Department of Supply, Melbourne (Australia). Antarctic Div.). [nd]. 18p. Dep. NTIS (U. S. Sales Only) $4.00.

The ionospheric total electric content (TEC) was measured continuously from Macquarie Island (54.5°S, 159°E, geog.) by monitoring the polarization angle of the radio beacon from the geostationary satellite INTELSTAT 2F-2. The ionosphere measured is often near or inside the auroral oval during evenings, and an association was found between TEC increases and auroral particle precipitation. Results from 31 March 1970 are examined. Correlation with all-sky camera photographs indicates a TEC increase caused by a multiple quiet arc structure. The average electron density was calculated from the TEC data in conjunction with the auroral dimensions determined from the photographs. The average electron density over a height range up to about 170 kms for a multiple quiet arc structure was 3.0×10^5 cm^{-3}. The subsequent breakup and poleward expansive phase of the substorm produced a further TEC increase. These results are in agreement with published rocket measurements. (auth)

27962 SOUND WAVE MODULATION OF AURORAL X RAYS. Wickersham, A. F. Jr. (Stanford Research Inst., Menlo Park, CA). Nature (London); 249: No. 5457, 538-540(7 Jun 1974).

Reference is made to an intense pulsation of auroral-associated x-rays following a solar cosmic flare in September 1966, detected by balloon borne scintillation counters. The x-rays were strongly modulated, with a period of 4 to 6 sec., and the spectrum hardened as the pulsations grew and then softened with the subsequent decay. There were two peaks in the x-ray power spectrum. It is stated that all these features could be interpreted as an interaction between atmospheric sound waves and a uniform flux of x-rays. The intensity modulation results from an atmospheric variable density absorber formed by the sound waves, the energy dependence of the modulation derives from the energy dependence of the x-ray absorption cross section, and the two peaks are possibly a result of ducting for each of the atmospheric sound channels. The latter factor is discussed, and there is stated to be substantial evidence that ducted sound waves in the upper atmosphere result from volcanic explosions and other natural causes, as well as from nuclear explosions. (UK)

27963 DETERMINATION OF TOTAL ELECTRON CONTENT FROM DIFFERENTIAL DOPPLER RECORDS. Tyagi, T. R. (Max-Planck-Instut fuer Aeronomie, Lindau, Ger.). J. Atmos. Terrest. Phys.; 36: No. 7, 1157-1164(Jul 1974).

Several existing and new methods of determining total electron content (I) from differential Doppler records obtained from orbiting satellites are examined. The relative accuracy of different methods is compared through simulated and actual examples. It is found that though in case of no- or linear-gradients all the methods give same results, only the method based on minimum curvature of I(t) curves is reliable in general case. (auth)

27964 GLOBAL DESCRIPTION OF THE F-REGION DURING THE IONOSPHERIC STORM OF 17 DECEMBER 1971. Schoedel, J. P. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.); Da Rosa, A. V.; Mendillo, M. J. Atmos. Terrest. Phys.; 36: No. 7, 1121-1134(Jul 1974).

Total electron content data—observed continuously by means of geostationary radio beacons—provide a good means to study the ionosphere during severe ionospheric storms. Data of 20 sites were collected in order to study the ionospheric storm of 17 December 1971. A remarkable increase in the total electron content occurred at mid-latitude stations throughout the northern hemisphere. Stations at auroral and equatorial latitudes also showed sharp increases which were both LT and latitude dependent whereas both sites in the southern hemisphere showed substantial depletions in the total electron content. (auth)

27965 STRONG ENHANCEMENTS OF AIRGLOW IN LOW LATITUDE REGIONS DURING MAGNETIC STORMS. Saito, B. I. (Niigata Univ., Japan). Rep. Ionosphere Space Res. Jap.; 27: No. 3, 105-107(Sep 1973).

Airglow was observed on December 17, 1971 and on November 13-14, 1960. The airglow on Nov. 13-14, 1960 showed the airglow enhancement in phase with the great substorm having a decreasing horizontal component of geomagnetic field and having increasing f_0F2 and decreasing h'F in ionospheric F layer. On the other hand, on December 17-18, 1971, such correlation was very weak. The study concerning the airglow on Nov. 1960 is reported in this paper. Data was taken at geomagnetic 22.2°N on board the Soya, a Japanese antarctic expedition ship. Remarkable enhancement occurred in both emission of 6300 Å and 5577 Å. The airglow enhancement was compared with the ionospheric f_0F2 and h'F at Kokubunji Radio Research Laboratory at geomagnetic 25.4°N. Two airglow peaks were in phase with the change in the ionospheric F layer. The results of observation are as follows. SAR arc (stable auroral red arc) was enhanced in phase with the other emission. The strong bursts of airglow emission appeared over entire meridional line at about same time, i.e., in the H_β emission observed at Fort Churchill (geomagnetic 68.0°N) and also in the 3914 Å, 5577 Å and 6300 Å emission observed at Memambetsu (geomagnetic 34.0°N). The strong bursts in the emission of 6300 Å and 5577 Å appeared at far lower latitude, geomagnetic 22.2°N. A model was obtained for the airglow process occurring in low latitude regions during severe magnetic storm. (auth)

27966 ENERGY SPECTRAL VARIATIONS DURING SVA PRECIPITATION EVENTS ON THE MORNING AND DAY SIDE OF THE AURORAL ZONE. Kangas, J. (Oulu Univ., Finland); Tanskanen, P.; Trefall, H.; Stadsnes, J.; Kremser, G.; Riedler, W. J. Atmos. Terrest. Phys.; 36: No. 7, 1269-1275(Jul 1974).

Energy spectral characteristics of auroral-zone X-ray events from electron precipitation are surveyed. The energy spectrum during morning SVA (slowly varying absorption) events is shown to vary in a systematic way: during the increasing phase of the SVA event softening of the X-ray flux occurs, but this is followed by a pronounced hardening. The softening phase is consistent with the energy-dependent effect of particle drift in the geomagnetic field thus supporting the drifting rain cloud model of morning electron precipitation events. The hardening phase may be attributed at least to some extent to energy-dependent effects of atmospheric and pitch-angle scattering processes. (auth)

27967 STUDY OF THE IONOSPHERIC ELECTRON CONTENT AT IBADAN, 1965–1968. Onwukwe, D. N. (Nigeria Univ., Nsukka). J. Atmos. Terrest. Phys.; 36: No. 7, 1259-1267(Jul 1974).

Results of the analysis of Faraday rotation of signals from the BE-B (S66) satellite are presented. These results indicate a 'bite-out' in the average diurnal cycle of the electron content which was not found in a previous study. Linear relationships for solar epoch control are established for the first time for Ibadan data and compared with results from other zones. Whilst the Ibadan data show a general agreement with other results in the correlation with solar flux index, S, they differ from other results in the correlation with the Zurich sunspot number index, R_z. (auth)

27968 CHANGES IN ATMOSPHERIC COMPOSITION INFERRED FROM IONOSPHERIC PRODUCTION RATES. Titheridge, J. E. (Auckland Univ., New Zealand). J. Atmos. Terrest. Phys.; 36: No. 7, 1249-1257(Jul 1974).

Changes in the total electron content of the ionosphere near sunrise are used to determine the integrated production rate in the ionosphere (Q) from 1965 to 1971, at latitudes of 34°S, 20°N and 34°N. The solar cycle change is given approximately by $Q \propto S-20$, where S is the 10.7 cm solar flux. All stations show a regular semiannual variation in Q, through a range of 1.3:1. This is interpreted as an increase in the ratio O/N_2 (the relative densities of atomic oxygen and molecular nitrogen) near the equinoxes. Northern hemisphere values of Q are nearly twice as large as southern hemisphere results, requiring an increase of about three times in the ratio O/N_2 in the northern hemisphere. This ratio decreases in summer, near solar maximum, giving the well-known seasonal anomaly in the ionosphere. The seasonal change is larger at 34°N than at 20°N, and is completely absent at 34°S. Measurements of the time at which sunrise production begins confirm that the absorption of solar radiation is primarily by N_2 at all times at 34°S, but changes from N_2 in summer to atomic oxygen in winter in the northern hemisphere near solar maximum. (auth)

27969 DIURNAL VARIATION OF IONOSPHERIC ABSORPTION OVER CALCUTTA. Khastgir, S. R. (Bose Research Inst., Calcutta); Ganguly, S.; Samanta, S. J. Geomagnet. Geoelec.; 25: No. 2, 145-157(1973).

A detailed investigation on the diurnal variation of ionospheric absorption over Calcutta at various frequencies shows that the absorption fits better with the relation $L \propto \cos^n \chi$ rather than with $L = A + B \cos\chi$, with the n values lying between 0.9 to 1.9 for different frequencies and seasons. The frequency dependence of the exponent n depends critically on the relative amount of the deviative and non-deviative losses. The diurnal variation of absorption also shows some asymmetry between the forenoon and afternoon values, the index n for the forenoon values being always greater than the afternoon values. The possibility of geomagnetic control over at least a part of the absorbing region has been invoked. (auth)

27970 SPORADIC-E LAYER OVER ISTANBUL. Bulat, T. (Istanbul Univ.). Istanbul Univ. Fen Fak. Mecm., Seri C; 36: No. 1-4, 1-10(1971).

The occurrence frequency of Es layer over Istanbul during a day is presented per cent of a day. Mostly this mentioned ratio is 95% during the summer months in Istanbul. In this study, firstly, monthly medians of the parameters of both foEs, fbEs, and h'Es are calculated then yearly variations of these parameters are investigated. The median value of foEs is obtained between 4.5—5.5 MHz for the summer months and the variation fbEs follows very closely the variation of foEs. Es layer disappears nearly in a day during the first and second months of a year. The apparent height of the Es layer is about 110 km over Istanbul. From the direct record ionograms, the variation velocity of electron density of Es layer over Istanbul is higher than the known values. (auth)

27971 ROCKET MEASUREMENTS OF PRECIPITATING ELECTRONS IN A SYSTEM OF MULTIPLE AURORAL ARCS. Boyd, J. S. College, AK; Univ. of Alaska (1974). 133p. University Microfilms Order No. 74-12,336.

Thesis (Ph. D.).

The pitch angle distributions of precipitating electrons with energies 2.5, 5 and 10 keV were measured by rocket-borne detectors in a system of multiple auroral arcs. A second 10 keV detector was carried on a separating forward section of the payload. Comparison of the data from the two sections showed strong spatial variations in the electron intensity, and a detailed correspondence was found between these variations and visible auroral forms. Overall variations in pitch angle distributions and the occurrence of peaked spectra in the bright arcs were consistent with previous observations. The observation of a peaked spectrum in the background aurora was unusual. The absence of an upper cutoff in the pitch angle distribution implies that low altitude parallel electric fields were not important in the acceleration of the electrons. Rather, the detailed structure of the pitch angle distribution shows that wave particle interactions must be responsible for the field-aligned intensities in bright auroral arcs. (Diss. Abstr. Int., B)

27972 PARAMETRIC AMPLIFICATION OF PROPAGATING ELECTRON PLASMA WAVES IN THE IONOSPHERE. Arnush, D.; Fried, B. D.; Kennel, C. F. (TRW Systems Group, Redondo Beach, CA). J. Geophys. Res.; 79: No. 13, 1885-1893(1 May 1974).

The linear parametric convective amplification of electron plasma waves by an O mode pump propagating vertically into a vertically stratified ionosphere is computed. The upshifted plasma line compares favorably with Arecibo observations, center frequency, spectral width, and possibly amplitude when the radar is aimed in a northerly direction. The dependence of the computed enhanced plasma line shape upon density scale length, electron-to-ion temperature ratio, pump power, density gradient scale length, and backscatter radar incidence angle is investigated. (auth)

27973 ROLE OF EDDY TURBULENCE IN THE DEVELOPMENT OF SELF-CONSISTENT MODELS OF THE LOWER AND UPPER THERMOSPHERES. Chandra, S. (Goddard Space Flight Center, Greenbelt, MD); Sinha, A. K. J. Geophys. Res.; 79: No. 13, 1916-1922(1 May 1974).

Numerical solutions of mutually coupled time-dependent equations of continuity, momentum, and energy balance are presented to illustrate the effect of eddy turbulence on the neutral composition and temperature of the lower and upper thermospheres. The procedure adopted eliminates the necessity of making ad hoc assumptions about the conditions at the turbopause level and allows the study of the two regions in a self-consistent manner. From the illustrative examples comprising parametric changes in eddy diffusion coefficient the specific roles of eddy turbulence in the development of theoretical models of the thermosphere are discussed. (auth)

27974 LIGHTNING-INDUCED ELECTRIC FIELDS IN THE IONOSPHERE. Dejnakarintra, M.; Park, C. G. (Stanford Univ., CA). J. Geophys. Res.; 79: No. 13, 1903-1910(1 May 1974).

In a recent paper the penetration of dc thundercloud electric fields into the ionosphere and magnetosphere (Park and Dejnakarintra, 1973) was discussed. The analysis is extended to the time-varying case and it is considered how electric field variations due to lightning are transmitted to ionospheric heights. The thundercloud is represented by a vertical dipole whose moment recovers exponentially with time following periodic lightning discharges. Electrical conductivity profiles are approximated by several piecewise exponential functions of altitude, and the anisotropy of the medium is taken into account above 70-km altitude. The source wave form is Fourier-analyzed, and electric fields at each harmonic frequency up to 10 Hz are mapped upward separately. The total electric field at any point in space is then obtained by adding all frequency components together. It is found that electric fields are transmitted upward more efficiently as the frequency increases. This compensates for the decrease with frequency in the amplitudes of the source spectrum, so that the electric field spectrum becomes fairly flat at large heights. In the time domain the recovery time following a lightning discharge decreases rapidly with altitude. At the 100-km level the electric field wave form appears as a sharp spike of ~100-ms duration. The peak amplitude of the spike may be several hundred microvolts per meter across the geomagnetic field at night. In the daytime the corresponding amplitude is about an order of magnitude smaller because of larger conductivities. These fields should be investigated as a possible excitation source of geomagnetic pulsations in the magnetosphere. (auth)

27975 EQUATORIAL COMPOSITION IN THE 137- TO 225-km REGION FROM THE SAN MARCO 3 MASS SPECTROMETER. Newton, G. P.; Kasprzak, W. T.; Pelz, D. T. (Goddard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 79: No. 13, 1929-1941(1 May 1974).

The neutral atmospheric composition experiment (Nace) carried by the San Marco 3 (SM 3) satellite measured the equatorial atmospheric composition during the reentry period of November 21–28, 1971. The mass density and molecular nitrogen density measured by the Nace are in agreement with values measured by rocket experiments and inferred from satellite experiments. The average total oxygen content measured by Nace is 30% below the value suggested by von Zahn at 150-km altitude. When it is assumed that his value for the molecular oxygen density at 150 km represents averaged rocket results applicable to the equatorial thermosphere, the Nace total oxygen content results in an atomic oxygen concentration comparable to the mean value of Cira (1965). The Nace helium measurements interpreted in terms of an altitude profile have an altitude distribution similar to that of molecular nitrogen below 165 km. The departure of helium from diffusive equilibrium is in the direction to require a large upward flux. The Nace argon results extrapolated below 168 km are in reasonable agreement with those of rocket experiments. There is good agreement in total mass density between the mass spectrometer and the drag measurements (both in situ and orbit decay) from SM 3. (auth)

27976 VARIATIONS IN THERMOSPHERIC COMPOSITION: A MODEL BASED ON MASS SPECTROMETER AND SATELLITE DRAG DATA. Jacchia, L. G. (Harvard Coll. Observatory, Cambridge, MA). J. Geophys. Res.; 79: No. 13, 1923-1927(1 May 1974).

The seasonal-latitudinal and the diurnal variations of composition observed by mass spectrometers on the Ogo 6 satellite are represented by two simple empirical formulas. The formulas are of a very general nature and predict the behavior of these variations at all heights and for all levels of solar activity; they yield a satisfactory representation of the corresponding variations in total density, as derived from satellite drag. It is suggested that a seasonal variation of hydrogen may explain the abnormally low hydrogen densities at high northern latitudes in July 1964. (auth)

27977 SPATIAL AND TEMPORAL BEHAVIOR OF ATOMIC OXYGEN DETERMINED BY Ogo 6 AIRGLOW OBSERVATIONS. Donahue, T. M.; Guenther, B.; Thomas, R. J. (Univ. of Pittsburgh). J. Geophys. Res.; 79: No. 13, 1959-1964(1 May 1974).

Maps are produced of the atomic oxygen density near 97 km showing a strong variation in latitude, longitude, universal time, and time of year. These densities are deduced from atomic oxygen green nightglow observations carried out from Ogo 6. Meridional wind patterns needed to support the asymmetries observed in local oxygen production and loss rates are deduced. (auth)

27978 RELATIONSHIP BETWEEN MICROSEISMS, GEOMAGNETIC ACTIVITY, AND IONOSPHERIC ABSORPTION OF RADIO WAVES. Lastovicka, J. (Geophysical Inst., Prague). Stud. Geophys. Geod.; 18: No. 3, 307-309(Jul 1974).

Relatively good correlation between such remote phenomena as microseisms, geomagnetic activity and ionospheric absorption of radio waves has been observed. These phenomena are probably connected by a considerably increased penetration of energetic particles into the atmosphere under conditions of geomagnetic activity. (auth)

27979 ABSORPTION CROSS SECTIONS OF STRATOSPHERIC MOLECULES. Hudson, R. D. (Johnson Space Center, Houston, TX). Can. J. Chem.; 52: No. 8, 1465-1478(15 Apr 1974).

Photoabsorption cross sections necessary for calculations of the equilibrium conditions in the stratosphere fall into two distinct classes: cross sections for molecular oxygen and ozone, which control the transmission of solar radiation; cross sections for minor atmospheric species, which are optically thin to solar radiation, and which are needed to calculate their rates of dissociation. The principal absorption features of molecular oxygen are absorption bands of the Schumann-Runge system between 175 and 200 nm and a weak dissociation continuum which extends from 175 to 260 nm. The band structure consists of many sharp rotational lines, and it is necessary to calculate cross sections using measured band parameters. Two measurements of the line widths for these bands have obtained large line widths (~1 cm^{-1}) indicating predissociation. The agreement between the two sets of data is good for only a few lines. This has implications in the calculation of the transmission of solar radiation to the lower stratosphere. The continua were measured by four groups. The results agree, within the respective experimental errors, near 220 nm, but disagree near 250 nm. Ozone has a continuous absorption spectrum between 175 and 300 nm with band structure above 300 nm. Four sets of data are available that agree within ±2%. The cross section above 300 nm is temperature dependent. The cross sections for the minor species are in general not as well known. In nitric oxide, carbon monoxide, ammonia, and sulfur dioxide, band structure dominates the absorption spectrum, and cross sections were measured at insufficient spectral resolution. Other species, such as nitric acid, hydrogen peroxide, water vapor, carbon dioxide, nitrous oxide, and nitrogen dioxide, have continua over the entire spectra range from 175 to 300 nm. Cross sections for these species were measured; however, cross sections for many molecules, e.g., N_2O_5, NO_3, etc., were not studied. (auth)

27980 TWILIGHT VARIATION OF THE AIRGLOW. II. [OI] 5577 A Line. Misawa, K. (Defence Academy, Yokosuka, Japan). Rep. Ionosphere Space Res. Jap.; 27: No. 3, 91-96(Sep 1973).

Zenith records of [OI] 5577 Å airglow intensities were obtained at Yokosuka (geomagnetic latitude + 25.0°, longitude 205.7°; geographic latitude 35°15′, longitude 139°44′) from September 1972 to July 1973. Two-color photometry was used. The use of a photometer with a refrigerator for photomultiplier resulted in reliable data of the airglow. Inflection points of the intensity enhancement in the morning twilight were found, which seemed to indicate the onset of the twilight activity of the green line emission. (auth)

27981 BOX MODEL CALCULATIONS FOR STUDYING THE VARIATION OF C-14 IN NATURE. Venkatavaradan, V. S. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A; 79: No. 5, 256-268(May 1974).

Theoretical treatment of C-14 variations in natural geophysical reservoirs using Box models are made. Analytical expressions are derived for the variation of C-14 for various cases such as a sudden variation or sinusoidal variation in its production rate. The numerical values are derived from the computer using simple programs to evaluate the comparatively complicated analytical expressions. (auth)

27982 EMPIRICAL RELATIONSHIPS BETWEEN F-REGION ELECTRON DENSITY AND TEMPERATURE AT MALVERN. Taylor, G. N.; Risk, R. J. (Royal Radar Establishment, Malvern, Eng.). J. Atmos. Terrest. Phys.; 36: No. 8, 1427-1430 (Aug 1974).

Empirical relationships between electron density and electron temperature are determined, using incoherent scatter measurements taken at noon at Malvern. Agreement is found with results for Arecibo given by Waldteufel and the analysis is extended to 640 km height. (auth)

27983 CHANGES IN CONCENTRATION OF OXYGEN AND HYDROGEN CONSTITUENTS IN THE MESOSPHERE DURING AN ECLIPSE. Thomas, L.; Bowman, M. R. (Science Research Council, Slough, Eng.). J. Atmos. Terrest. Phys.; 36: No. 8, 1421-1426(Aug 1974).

Numerical solutions of the diffusion and continuity equations are used to examine the changes in concentration of constituents in an oxygen-hydrogen atmosphere during a solar eclipse. The height distributions of atomic oxygen, ozone, and atomic hydrogen at particular times during and following the eclipse are presented, and the relative variations of these and other constituents at representative heights are also given. (auth)

27984 RADAR STUDIES OF SMALL-SCALE PLASMA IRREGULARITIES IN THE EQUATORIAL ELECTROJET. Fejer, B. G. Ithaca, NY; Cornell Univ. (1974). 202p. University Microfilms Order No. 74-18,091.

Thesis (Ph. D.).

Small scale density irregularities in the equatorial electrojet are studied using highly improved radar techniques. It is shown that the Type II irregularities are definitely due to the gradient-drift instability. Observations of backscattered power versus height show a significant difference between the daytime and nighttime. During daytime the profile shows a single peak at about 104 km and echoes are observed between 93 km and 113 km, while at night the power profiles are strongly layered and echoes are observed up to about 130 km. Spectral observations with excellent height and time resolution indicate a significant height variation of the phase velocity of the unstable waves. Oblique Type I irregularities are only observed in the upper portion of the electrojet backscattering region (above about 105 km). Spectra from vertically propagating waves indicate a strongly turbulent electrojet medium. Counter-electrojet effects (i.e., anomalous reversals of the current) are observed during both magnetically

quiet and disturbed periods. A general linear field theory is derived and the limitations of the experimental techniques used for electrojet studies are discussed. (Diss. Abstr. Int., B)

27985 STUDY OF THE AURORAL SUBSTORM BY SOUNDING ROCKET. Kintner, P. M. Jr. Minneapolis; Univ. of Minnesota (1974). 146p. University Microfilms Order No. 74-17,258.

Thesis (Ph. D.).

The auroral substorm, as a large scale event associated with plasma changes deep in the magnetosphere, is probed with an instrument sounding rocket. The experiment is designed to detect electric fields and currents in the ionosphere. A paradigmatic motivation is established for anticipating the flow of currents in the ionosphere including magnetic field-aligned currents. The payload experiments are an electric field meter, a vector magnetometer and a Langmuir probe. Their design and construction is discussed as well as critical design parameters in the ionosphere. From on board aspect measurements, a model reproducing the payload dynamics is developed. This model is used to remove effects due to the earth's magnetic field and payload motion. Hence Lorentz force potentials are removed from the electric field results and the remaining vector magnetic field is the result of currents. A current model is developed whose magnetic field reproduces the observed magnetic field. The observed electric field allows identification of Hall and Pedersen currents. The current model is consistent with ground measurements and in flight electron measurements. The nature of the auroral event is documented with ground cameras, magnetometers, and scanning photometers. The conclusion is reached that during an auroral substorm a Hall current flows westward while in the same region a southward Pedersen current flows. The Pedersen current is terminated in field-aligned currents. The surprising result is discovered that the Pedersen current is depositing as much energy into the ionosphere as precipitating electrons are. (Diss. Abstr. Int., B)

27986 TWO DAYS IN THE LIFE OF THE IONOSPHERE OVER ARECIBO. Swartz, W. E. (Cornell Univ., Ithaca, NY); Ioannidis, G. A.; Shen, J. S.; Brice, N. M.; Rowe, J. F. Radio Sci.; 9: No. 8-9, 769-775(1974).

High resolution incoherent scatter electron density data using Barker-coded pulses are presented for two separate 24-hr periods of very different magnetic conditions. The first period in April 1972 was magnetically quiet while the second period spanned parts of two of the five most magnetically disturbed days in July 1972. Solar activity was low with 2800-MHz indices of 129 and 128 for the April days and indices of 109 and 117 for the July days. Contour plots and selected profiles are presented that show larger sporadic-E layers and stronger gravity-wave effects during the disturbed night than during the quiet night. (auth)

27987 MONTE CARLO TECHNIQUE FOR FINDING THE IMPULSE RESPONSE OF STRATIFIED COLD PLASMA. Gray, K. G.; Bowhill, S. A. (Univ. of Illinois, Urbana). Radio Sci.; 9: No. 8-9, 789-798(1974).

A Monte Carlo technique is described for finding the response of a horizontally stratified cold plasma to a plane impulsive wave at vertical incidence. The effects of electron collisions with neutral particles and a vertical magnetic field are included in the analysis. The technique is arrived at by replacing a continuous scattering process (by continuous is meant that the electrons are uniformly distributed through any horizontal plane in the plasma) with a sequence of scatters. All orders of scatter are computed from this sequence of scatters, and the Monte Carlo approximation to the exact solution is the sum over these orders of scatter. The method is applicable for any electron density function N(z), collision frequency, or cyclotron frequency. The Monte Carlo solution presented here is valid only for small and intermediate values of time; the solution diverges for large values of time. The Monte Carlo method is applied to the uniform half-space problem since there are exact and approximate analytical solutions to compare with the Monte Carlo results. (auth)

27988 ELECTRON COLLISION PROCESSES IN THE IONOSPHERE. Mantas, G. P. Urbana, IL; Univ. of Illinois (1973). 378p. University Microfilms Order No. 74-12,098.

Thesis (Ph. D.).

A re-examination of the electron gas cooling and heating rates, and a rigorous theoretical study of the thermalization and transport of photoelectrons in the earth's atmosphere are presented. The rate of energy exchange, through elastic collisions, between two gases in thermal disequilibrium is derived from elementary considerations. This formula is applied to calculate energy transfer rates, and collision frequencies for energy transfer, in plasmas at thermal disequilibrium. Estimates are given for energy transfer rates, effective collision frequencies, and mean momentum transfer cross sections, over a wide range of ion and neutral gas temperatures, for a number of ion/neutral pairs found in the earth's atmosphere. A new theoretical approach for the calculation of the steady-state photoelectron energy spectrum in the ionosphere is presented. Photoelectron transport, elastic collisions with neutrals and ions, secondary electron production, energy degradation by excitation of the discrete energy states of the neutral atmospheric constituents, and by continuous energy transfer to the thermal electron gas are included in a manner consistent with the Boltzmann equation which constitutes the foundation of the theory. The derivation of an integral-differential equation governing the thermalization and transport of photoelectrons in the atmosphere is presented in detail. A numerical method for the solution of this equation is discussed. The theory is applied to two ionospheric models appropriate for dawn and noon conditions using electron densities measured over Arecibo and primary photoelectron energy spectra consistent with the neutral particle densities measured over the same station. Numerical calculations of photoelectron flux energy and pitch angle spectra, in the energy region 1-100 eV for all altitudes between 120 and 1000 km, are presented. (LBS)

27989 DISPERSIVE MOTIONS IN THE EQUATORIAL IONOSPHERE. Misra, R. K. (Physical Research Lab., Ahmedabad, India). Radio Sci.; 9: No. 8-9, 733-739(1974).

The results of the dispersion analysis of the spaced receiver records of fading for an equatorial station in the Indian zone are discussed. It is shown that the apparent drift speed increases almost linearly with the frequency of fading in all the cases studied for both the E and F regions. The dispersion of drift speed is larger for the F region than for the E region in general. Furthermore, the F region shows a larger dispersion during the daytime whereas it is of the same order in the day and nighttimes for the E region. The drift speed corresponding to the highest Fourier frequency present in a particular record is found to be close to the apparent drift speed V_a as determined from the shift of the peak of cross correllograms while the total frequency spread of the speed is linearly related to the random drift speed V_c derived by the full correlation analysis. Several possible causes of dispersion in the ionosphere such as gravity waves, independently moving reflecting screens, height gradient of the horizontal drift and size of irregularities, the dispersive nature of the vertical drift velocity, and the variability of the drift during the course of record are discussed. Interference of the signals reflected from two or more highly aspect-sensitive areas in the ionosphere is suggested as a possible mechanism resulting in the positive and linear dispersion observed on the ground at an equatorial station. (auth)

27990 FIELD-ALIGNED CURRENT OBSERVATIONS IN THE POLAR CUSP IONOSPHERE. Ledley, B.G.; Farthing, W.H. (NASA Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 79: No. 22, 3124-3128 (1 Aug 1974).

Vector magnetic field measurements made during a sounding rocket flight in the polar cusp ionosphere show field fluctuations in the lower F region are interpreted as being caused by the passage of the pay load through a structured field-aligned current system. The field-aligned currents have a characteristic horizontal scale size to about 1 km. Analysis of one large field fluctuation gives a current density of 10^{-4} A/m^2. (auth)

27991 VHF IONOSPHERIC SCINTILLATIONS AT L = 2.8 AND FORMATION OF STABLE AURORAL RED ARCS BY MAGNETOSPHERIC HEAT CONDUCTION. Basu, S. (Institute of Radio Physics and Electronics, University of Calcutta, Calcutta, India). J. Geophys. Res. 79: No. 22, 3155-3160 (1 Aug 1974).

The 137-MHz amplitude scintillation data obtained from the ATS 3 satellite at a mid-latitude station (L = 2.8) are utilized to study the temporal behavior of electron density irregularities following sudden commencements of intense magnetic storms. Comparison with the equatorial Dst index shows that the onset of scintillations is controlled by the universal time of commencement of the main and rapid recovery phase of storms. Total electron content data obtained simultaneously are used to show that the plasmapause-associated ionospheric trough moves to the vicinity of the observing point during the onsets of such universal timecontrolled scintillations. The magnetospheric heat conduction into the ionosphere during these storms, which sometimes causes stable auroral red arcs near the plasmapause, is found to produce field-aligned irregularities. A persistence of local time dominated scintillations following such storm time onsets is noted. The results of this study indicate that mid-latitude scintillations following large magnetic storms may have a storm time component in addition to the widely known local midnight component. (auth)

27992 FIELD-ALIGNED CURRENTS AND THE AURORAL ELECTROJET. Cahill, L.J.; Potter, W.E.; Kintner, P.M. (School of Physics and Space Center, University of Minnesota, Minneapolis, Minnesota 55455); Arnoldy, R.L.; Choy, L.W. J. Geophys. Res. 79: No. 22, 3147-3154 (1 Aug 1974).

A Nike Tomahawk with fields and particles pay load was launched from Poker Flat, Alaska, at 1230 UT, November 18, 1970, over a strong westward electrojet current and auroral forms moving rapidly to the east. Electron fluxes moving up and down the magnetic field lines were measured. Upward–moving electrons below 1–keV energy were dominant and were equivalent to a net downward electric current that fluctuated between 2 and 6×10^{-7} A m^{-2} during the flight above 130 km. As the rocket traversed this broad region of downward electric current over to the north of the auroral forms, the horizontal electric field slowly rotated from east to west. The magnetic measurements indicate that the westward elecrojet was a horizontal sheet of current hundred kilometers in north–south extent. (auth)

27993 STIMULATION OF THE HARRIS INSTABILITY IN THE IONOSPHERE. Benson, R.F. (Laboratory for Planetary Atmospheres, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Maryland 20771). Phys. Fluids 17: No. 5, 1032-1037 (May 1974).

Satellite soundings of the topside ionosphere reveal diffuse signals on the low frequency side of nf_H when $nf_H < f_T$, where n is an integer and f_H and f_T are the electron cyclotron and upper hybrid frequencies, respectively. They extend no further than the midway point between $(n-1)f_H$ and nf_H. The present observing conditions allow detection up to n=10. The origin of the signals is attributed to the Harris instability of longitudinal plasma waves when $T_\perp/T_\parallel > 2n$, where $T_\perp$ and $T_\parallel$ refer to the temperature corresponding to the electron motion perpendicular and parallel to the earth's magnetic field, respectively. The large anisotropies are caused by collisionless cyclotron damping of energy from the high power sounder pulse. This energy is absorbed in a region which extends radially from the antenna, a distance which is small compared with the antenna length but large compared with the antenna sheath region. (auth)

27994 FURTHER DISCUSSION OF THE CYCLOTRON INSTABILITY. Lin, C.S. (Physics Department and Space Sciences Division of the Geophysics Program, University of Washington Seattle, Washington 98195); Parks, G.K. J. Geophys. Res. 79: No. 19, 2894-2897 (1 July 1974).

The cyclotron instability is examined for arbitrary ratios of hot– to cold–plasma densities, resonant velocities, and wave frequencies. We find that the cyclotron linear growth rate has a maximum when the resonant velocity is near the thermal velocity of the plasma distribution. A criterion for increasing the growth rate by increasing the cold–plasma density is derived. (auth)

27995 FRANCO–SOVIET ARAKS PROJECT. Aubert, M. (Centre National d'Etudes Spatiales, Paris). Rech. Spatial; 13: 9-14(1974). (In French).

The ARAKS (Artificial Aurora between Kerguelen and Sogra) experiment, launched in conditions of calm magnetosphere, should make it possible to localize, by optical observations carried out from the ground, the conjugate point of the place where the Eridan rocket is found, at about 300 m, while the best models of the terrestrial magnetic field do not permit an accuracy above 100 km. The scientific goals are the determination of conjugate points, particular phenomena, and wave generation phenomena. Specifications connected with the scientific objectives are discussed. Eridan useful load comprises the equipment necessary for injection of the beam neutralization of the charge, and measurement of particles. (IAA)

27996 DIFFUSION-RECOMBINATION MECHANISM OF IONIZED LAYER FORMATION IN THE F2 REGION OF THE IONOSPHERE. Khantadze, A. G. (Inst. of Geophysics, Tiflis, USSR). Soobshch. Akad. Nauk Gruz. SSR; 72: 561-563(Dec 1973). (In Russian).

27997 TURBULENT EFFECTS IN THE LOWER IONOSPHERE. Ginzburg, E. I.; Zhalkovskaya, L. V. (Inst. of Geology and Geophysics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 3, 301-324(1974). (In Russian).

This review covers various methods of observing wind fluctuations at heights of the lower ionosphere (60 to 120 km). This survey summarizes the experimental and theoretical data describing the details of the random wind field in the upper atmosphere. These variations are brought about by a developed turbulence for which the energy distribution in the spacial spectrum is mainly determined by a cascade energy transfer from a large scale to a small scale. By this approach success has been attained in understanding features in the height distribution of temperature, minor atmospheric components and turbulent flux parameter. Further theoretical and experimental studies of turbulent effects should be stimulated. The problems are many. For example, in order to compare the experimental and theoretical data more correctly, it is necessary to estimate the effect of temperature and wind stratification on the form of the structural functions with anisotropy being taken into account. It is also necessary both experimentally and theoretically to determine the type of mutual relation of wave motions with the turbulent structure under ionospheric conditions. Theoretical studies in this direction are almost entirely lacking, and the experimental studies are few. By solving this problem it will be possible to estimate reliably the relative role of turbulence in the dynamic effects of the lower ionosphere. (SJR)

27998 FARADAY ROTATION STUDIES IN AFRICA DURING THE SOLAR ECLIPSE OF JUNE 30, 1973. Hunter, A. N. (Univ. of Lancaster, Eng.); Holman, B. K.; Feldgate, D. G.; Kelleher, R. Nature (London); 250: No. 5463, 205-206(19 Jul 1974).

An attempt was made to observe variations of the total electron content of the ionosphere during the solar eclipse of June 30th 1973 from four stations in southern and eastern Africa. Each station was equipped with a conventional Faraday rotation recording system consisting of a receiver and a mechanically rotating aerial. The amplitude fading of the 137 MHZ signals from the geostationary satellite Intelsat HF3, located at approximately 14°W, was recorded. The four stations operated for a total period of 10 days, including the day of the eclipse. Previous observations made at the times of earlier eclipses are briefly referred to. Perturbations of the total electron content of at least 15% were expected during the 1973 eclipse, but the observations showed no fluctuations identifiable with the eclipse. It is concluded that if there were any travelling ionospheric disturbances, induced by the eclipse, they produced variations of less than 1% in the total electron content, much smaller than anticipated. This raises doubts concerning the validity of theories predicting such variations and the interpretation of previous observations. (UK)

27999 LOW-RADIOACTIVITY CENTER AT GIF-SUR-YVETTE. Bull. Inform. Sci. Tech. (Paris); No. 187, 49-91(Dec 1973). (In French).

The Centre des Faibles Radioactivites in Gif-sur-Yvette is funded by CNRS and CEA. It was created in 1961 to apply the nuclear methods in earth sciences. The principal topics studied are geophysics, oceanography, cosmophysics, and archeology. The main results obtained during 1971 and 1972 are summarized. (FR)

28000 EXPERIMENTAL VALUES FOR THE 511 keV γ-LINE INTENSITY IN THE UPPER LAYERS OF THE ATMOSPHERE. Estulin, I. V.; Ivanov, V. P. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 6, 862-864(1973).

Translated from Kosm. Issled.; 11: No. 6, 956-957(1973).

Possible causes for the disagreement in experimental data are examined. The intensity of the line $N_\gamma(511)$ is dependent on residual atmosphere p. The value of the 511 keV γ-line, extrapolated to the edge of the atmosphere $N^0_\gamma(511)$, is presented in the form: $N^0_\gamma(511) = a_0 + a_{ins} + a_{alb}$, where a_{alb} is the albeda radiation intensity leaving the atmosphere, and a_{inst} is the annihilation radiation occurring in the instrument, including activation, with a_{alb} and a_{inst} dependent on the cosmic-ray flux. The value a_0 is the extraterrestrial component of the 511-keV line, unrelated to the cosmic-ray flux around the earth. Suggestions are made for more accurate experiments. (MHR)

28001 AURORAL SPECTRUM EMISSIONS THEORY. Citrynell, H. (Univ., Stockholm). Indian J. Phys.; 48: No. 2, 179-187 (Feb 1974).

A theory concerning the calculation of intensities of auroral spectral lines and bands is presented. The theory introduces a new concept of effective impact cross sections for the excited and ionized states of the atmospheric components and also eliminates the necessity of calculating secondary electrons in order to obtain the volume emission rates for spectral lines and bands. (auth)

28002 POROSITY IN THE IRREGULAR STRUCTURE OF THE IONOSPHERE ACCORDING TO OBSERVATIONS WITH THE KOSMOS 381 SATELLITE. Al'pert, Ya. L.; Vitshas, L. N. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 6, 803-808(1973).

Translated from Kosm. Issled.; 11: No. 6, 890-896(1973).

From radio observations of the difference $\delta\dot{\phi}$ in the Doppler frequency shifts of pairs of coherent radio waves transmitted from the Kosmos 381 satellite by the radio station Mayak in December 1970, the dependence of the "porosity" $\alpha(\rho_\theta)$ in the irregular structure of the ionosphere, the fluctuations $\Delta(\delta\dot{\phi})$, and the relative fluctuations $\Delta(\delta\dot{\phi})/\delta\dot{\phi}$ upon the linear size ρ_θ of the irregularities has been determined. Earlier data obtained with the Élektron 1 and 3 satellites are used for comparison. The range of ρ_θ values considered, from 0.2 to 0.3 to 1000 km, is split into three subintervals at 10 and 100 km. Statistical means of the quantities $\alpha(\rho_\theta)$, $\Delta(\delta\dot{\phi})$, and $\Delta(\delta\dot{\phi})/\delta\dot{\phi}$ are computed for each subinterval. The results measure the filling of the outer ionosphere with irregularities of various sizes and the variability of the quantity $\Delta(\delta\dot{\phi})$ due to electron–density fluctuations δN at the 900 to 1100-km level as well as in the entire height range z_C = 400 to 2300 km. (auth)

28003 MODEL INVESTIGATIONS OF RADIO WAVE PROPAGATION IN THE LOWER IONOSPHERE TO DETERMINE ELECTRON DENSITIES FROM MF PULSE SOUNDING. Gruschwitz, E. H. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). Radio Sci.; 9: No. 7, 659-667(Jul 1974).

Full-wave calculations are described to investigate the propagation of MF radio waves in the range from 255 to 950 kHz in the lower ionosphere. The method of investigation makes use of matrix multiplications with the ionosphere divided into homogeneous layers of 100-m thickness. The model calculations provide conclusions from MF pulse sounding results on electron density and collision frequency profiles in the height interval from 50 to 100 km. The diurnal variation of electron density in the lower ionosphere is presented. Reflections observed from heights of about 75 and 87 km during the day are shown to be produced by steep gradients of electron density. (auth)

28004 CORRECTIONS AND ERROR ESTIMATES OF ELECTRON DENSITY PROFILES OBTAINED FROM IONOGRAMS. Paul, A. K. (National Oceanic and Atmospheric Administration, Boulder, CO). Radio Sci.; 9: No. 7, 669-673(Jul 1974).

Electron density profiles derived from ionograms have limited accuracy due to technical and natural reasons. In the following it is shown how corrections and error estimates can be obtained on the basis of the propagation theory of radio waves and the general knowledge of the ionospheric structure. (auth)

28005 HIGH LATITUDE IONOSPHERIC IRREGULARITY MODEL. Pope, J. H. (National Oceanic and Atmospheric Administration, Boulder, CO). Radio Sci.; 9: No. 7, 675-682(Jul 1974).

Modifications were made to the global scintillation model that was developed by Fremouw (Stanford Research Institute), to better represent recent high latitude scintillation data. These modifications were made primarily in the high latitude term of the model and include a provision for variation in the position of the scintillation boundary with respect to magnetic activity. The resulting model is compared with published curves of scintillation activity with respect to latitude and is found to produce a considerably better agreement with those curves than the original model. A modification of the model is made to represent the finding that the northern and southern polar regions of the scintillation activity are not symmetrical with respect to each other. (auth)

28006 DISCUSSION OF POSSIBLE NEGATIVE ION DETACHMENT MECHANISMS IN THE SUNRISE D REGION. Turco, R. P. (R and D Associates, Santa Monica, CA). Radio Sci.; 9: No. 7, 655-658(Jul 1974).

Many recent measurements of photochemical rate constants and atmospheric ion composition have changed our understanding of D-region sunrise processes. Several new sunrise mechanisms are suggested in the light of the recent data. It is concluded that very stable hydrated negative ions will probably be converted by chemical reaction at sunrise into less stable hydrates which can be photodetached. (auth)

28007 RADIO WAVE PROPAGATION AND THE IONOSPHERE. Volume 2. Propagation of Electromagnetic Waves Near the Earth. Al'pert, Y. L. New York; Plenum Publishing Corp. (1974). 278p. $37.50.

Translated from Russian by Richard B. Rodman.

Electromagnetic waves of natural origin having frequencies as low as a few hertz are discussed. In the investigation of various types of electromagnetic waves and vibrational processes, the propagation laws in plasma and waveguides near the surface are explored and their generation and interaction with plasma and particle streams are examined. In addition, the development of new techniques for diagnosing structure and properties of plasma near the earth is surveyed. Among the topics discussed are: investigations of the propagation of low-frequency waves near the earth's surface, the propagation of low-frequency waves along magnetic field lines, and the properties of VLF, ELF, and UHF waves. (MHR)

28008 EQUILIBRIUM AND STABILITY PROPERTIES OF RELATIVISTIC E-LAYERS AND ELECTRON RINGS. Mahajan, S. M. College Park, MD; Univ. of Maryland (1973). 158p. University Microfilms Order No. 74-17,051.

Thesis (Ph. D.).

Equilibrium and stability properties of magnetically confined partially-neutralized relativistic thin electron rings and E-layers are studied within the framework of Vlasov-Maxwell equations. The collisionless skin depth $c/\omega_p \gg (a,b)$, the minor dimensions of the system, is assumed throughout the analysis. Two examples of distribution function are used to investigate equilibrium properties including density profile, transverse temperature profile, closed expressions for the minor dimensions of the system, etc. A linear electrostatic stability analysis is carried out for the E-layer and electron ring equilibria described by the distribution function $f_e^0(H,P_\theta) = \delta(P_\theta - P_0)\ \delta(H - \gamma_0 mc^2 + e\bar{\Phi}_0)$ assuming a fixed ion background ($m_i \to \infty$). For the E-layer, the perturbed Poisson's equation is solved to obtain dispersion relations in various limiting regimes. The stability criteria are derived and discussed. The effects of self fields on the stability criteria are analyzed. The E-layer exhibits the negative-mass instability as well as the diochotron instability. The instability growth rates are evaluated and discussed in various regimes including the effects of surface charge perturbations. In a similar fashion, the stability analysis is carried out for the electron ring. For the electron ring the lowest-order effects of betatron oscillations, which modify the angular frequency ω_c, are also retained in the analysis, and their stabilizing influence is discussed. The growth rate of the instability is computed in the unstable regime. The synchrotron radiation spectrum is calculated for the electron ring. Since individual electrons execute betatron oscillations about a mean radius R_0, the single-particle emission spectrum is modified from the conventional [Schott-Trubnikov] result. The spectrum of radiation emitted by all electrons in the ring is obtained by averaging the single particle spectrum over the distribution function $f_e^0(H,P_\theta)$. For the class of ring equilibria self-consistently described by $f_e^0(H,P_\theta) = \delta(P_\theta - P_0)\ F(H)$, it is shown that a knowledge of the l'th harmonic emission spectrum is sufficient information to reconstruct F(H) in detail. Similar synchrotron emission calculation is carried out for the thin relativistic E-layer. (Diss. Abstr. Int., B)

28009 CURRENT PROBLEMS IN TERRESTRIAL IONOSPHERIC BEHAVIOR. Furman, D. R. Gainesville, FL; Univ. of Florida (1973). 250p. University Microfilms Order No. 74-19,145.

Thesis (Ph. D.).

Four ionospheric problems were studied. The first is a high time resolution study of the loss and transport in the F region. The second problem concerns recent suggestions that the observed values of the solar EUV flux be doubled. The effect of gravity waves on ionospheric temperature and composition is the third problem undertaken. Problem number four is a time dependent study of a model aurora. (Diss. Abstr. Int., B)

Effects of Nuclear Detonations

28010 PHOTOCHEMICAL WAR ON THE ATMOSPHERE. Hampson, J. (Univ. of Laval, Quebec). Nature (London); 250: No. 5463, 189-191(19 Jul 1974).

Some of the changes in the photo-chemical regime of the atmosphere, which may be wrought by nuclear explosions, are outlined and it is suggested that these effects must be considered in future talks on arms limitation. (auth)

Magnetospheric Phenomena

Refer also to abstracts 27798, 27871, and 27978.

28011 (AD-773132) EARTH'S PARTICLES AND FIELDS, 1973. Final Report, May–December 1973. McCormac, B. M.; Evans, J. E. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). Dec 1973. Contract N00014-73-C-0376. 55p. (LMSC-D-356744). NTIS $3.75.

The Summer Advanced Study Institute, "Earth's Particles, and Fields," was held at The University, Sheffield, England, during the period August 13 to 24, 1973. There were 139 participants from 16 countries. Over 40 lectures were presented with approximately one-half of the time devoted to discussion. Lectures and discussions about theoretical and experimental research results concerning the structure and characteristics of the magnetosphere, magnetospheric models, convection and electric fields, substorms, and the Jovian magnetosphere are summarized. (GRA)

28012 (AD-773935) EFFECTS OF INTERPLANETARY SHOCK WAVES ON ENERGETIC CHARGED PARTICLES. Progress Report. Sarris, E. T.; Van Allen, J. A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jan 1974. Contract N00014-68-A-0196-0003. 76p. NTIS $4.00.

The influence of interplanetary shock waves on energetic charged particles is studied in this work. Emphasis is given to the acceleration of protons in almost perpendicular shock waves (the angle psi between the shock normal and the upstream magnetic field being greater than about 80 degrees). The special

case of protons accelerated in ideal perpendicular shock waves is treated analytically. (GRA)

28013 (AD-775006) CHARACTERISTICS OF MAGNETOSPHERIC SUBSTORMS AND THEIR EFFECTS UPON SPACECRAFT: A SELECTED BIBLIOGRAPHY. Le Jeune, W. R.; Magnolia, L. R. (TRW Systems Group, Redondo Beach, Calif. (USA)). Oct 1973. 45p. NTIS $5.25.

During the past 15 years many different NASA-launched satellites in earth orbit and deep space have collected an enormous amount of data which has been used to develop detailed models of the earth's magnetic field and plasma environment. Several of the spacecraft in the outer magnetosphere have experienced anomalous behavior and sometimes failures which, in most cases, were unexplained. Recently, some of these unwanted space events have been correlated with magnetospheric substorms. In an effort to shed more light on this problem and to facilitate research in this area the authors have prepared this bibliography. It is divided into two parts: Characteristics of magnetospheric substorms, and effects upon spacecraft. This material provides scientists and engineers a present day description of the substorm environment and consequences upon synchronous satellites. The space environment articles were limited to post- 1967 papers to provide the latest information on the fast developing definition of magnetospheric substorm phenomena. (GRA)

28014 (AD-775080) FORTRAN PROGRAM FOR COMPUTING STEADY-STATE COMPOSITION MODELS OF THE UPPER ATMOSPHERE. Air Force Surveys in Geophysics. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). [nd]. vp. NTIS $5.00.

A phenomenological model of the interplay between the polar magnetic fields of the sun and the solar sector structure is discussed. Current sheets separate regions of opposite polarity and mark the sector boundaries in the corona. The sheets are visible as helmet streamers. The solar sector boundary is tilted with respect to central meridian, and boundaries with opposite polarity change are oppositely tilted. The tilt of a given type of boundary ((+,–) or (–,+)) changes systematically during the sunspot cycle as the polarity of the polar fields reverses. Similar reversals of the position of the streamers at the limbs take place. Observational evidence in support of the model is presented, especially the findings of Hansen, Sawyer and Hansen and Koomen and Howard that the K-corona is highly structured and related to the solar sector structure. (GRA)

28015 (AD-775556) GEOMAGNETIC RESPONSES TO THE SOLAR WIND AND TO SOLAR ACTIVITY. Svalgaard, L. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). 8 Nov 1973. Contract N00014-67-A-0112-0068. 73p. (SU-IPR-555). NTIS $3.75.

A unified overview of present knowledge of the geomagnetic response to the dynamic solar wind is presented. Physical understanding rather than observational details is emphasized. Following some historical notes, the formation of the magnetosphere and the magnetospheric tail is discussed. The importance of electric fields is stressed and the magnetospheric convection of plasma and "frozen-in" magnetic field lines under the influence of large-scale magnetospheric electric fields is outlined. Ionospheric electric fields and currents are intimately related to electric fields and currents in the magnetosphere and the strong coupling between the two regions is discussed. The energy input of the solar wind to the magnetosphere and upper atmosphere is discussed in terms of the reconnection model where interplanetary magnetic field lines merge or connect with the terrestrial field on the sunward side of the magnetosphere. (GRA)

28016 (NOAA-TM-ERL-SEL-26) PROCEEDINGS OF THE CHAPMAN MEMORIAL SYMPOSIUM ON MAGNETOSPHERIC MOTIONS, BOULDER, COLORADO, JUNE 18–22, 1973. Campbell, W.; Matsushita, S.; Speiser, T. (eds.). (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA). Environmental Research Labs.). Oct 1973. 218p. (CONF-730694-).

The Chapman Symposium Proceedings contains extended abstracts of eighty-one papers presented. The topics are arranged in the following groups: magnetopause; magnetospheric models; polar cap and cusp regions; magnetotail; emissions and pulsations; ring current; plasmasphere; auroral phenomena, and substorm dynamics. (LBS)

28017 MODEL FOR PROPAGATION OF DUPLICATE WHISTLERS AT GEOMAGNETIC LATITUDES EXCEEDING 30°. Raichovski, T. M. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 3, 345-347(1974).

The concept of whistlers previously described quantitatively is broadened. The observatory in Sofia is at a relatively higher latitude than that used in previous work. Characteristics of the whistlers are described, and a possible model of dispersion for duplicate whistler atmospherics is shown schematically. (JFP)

28018 GUIDANCE OF WHISTLER WAVES IN THE MAGNETOSPHERE, ALONG FIELD-ALIGNED IRREGULARITY WITH A QUARTIC DISTRIBUTION OF IONIZATION DENSITY. Okuzawa, T.; Yamanaka, K. (Univ. of Electro-Communications, Tokyo). J. Geomagnet. Geoelec.; 25: No. 3, 297-312(1973).

A numerical study is made on the ducted-whistler propagation in the magnetosphere by using the phase-integral technique. The guidance in the present model takes place along a dipole field-aligned irregularity with a slowly varying, quartic distribution of ionization density. Numerical calculations are made on the track widths, the mode angles, and the travel times of trapped modes for a wide range of irregularity parameters. Calculations are carried out for a field line for which the shell parameter L = 2, Angerami and Thomas's model of ionization density being employed as a background component of the plasma distribution. It is shown that an increase in the transverse size of irregularity may not be responsible for the increase in whistler diffuseness. (auth)

28019 ELECTROSTATIC WAVES AT HALF ELECTRON GYROFREQUENCY. Young, T. S. T. (Univ. of California, Berkeley). J. Geophys. Res.; 79: No. 13, 1985-1988(1 May 1974).

Instability analysis shows that the wave observations at frequencies slightly above one half of the electron gyrofrequency (Coroniti et al., 1971) in the trapping region ($4 \lesssim L \lesssim 10$) were likely to be caused by two species of electrons with comparable densities: a cold species and a warm species that has a small temperature anisotropy ($2.0 \lesssim T_{\perp w}/T_{\parallel w} \lesssim 2.5$). The scarcity of detection of these waves relative to that of the second-half harmonic waves near one and a half of the electron gyrofrequency can be interpreted as evidence that the distribution function of the warm electrons is more often nonmonotonic in $v_\perp$ than temperature anisotropic in the trapping region. (auth)

28020 EXPERIMENTAL OBSERVATION OF WHISTLER TRIGGERED ELECTRON - CYCLOTRON INTERACTIONS IN THE MAGNETOSPHERE. Foster, J. C. College Park, MD; Univ. of Maryland (1973). 186p. University Microfilms Order No. 74-11,651.

Thesis (Ph. D.).

The observation of bremsstrahlung x-rays produced by the electron precipitation associated with the generation of bursts of discrete VLF emissions is analyzed. 1 sec bursts of x-rays with energies > 30 keV were measured at balloon altitude over Siple Station, Antarctica (L = 4.2) on January 2, 1971. A one-to-one correlation with whistler triggered bursts of VLF rising tones in the 1500–3800 Hz frequency range was observed for ~25 min. Cross correlation and power spectral analysis of the x-ray count rate and VLF amplitude are presented. Propagation characteristics of VLF waves and electrons in the magnetosphere are investigated. To explain the burst generation a mechanism is proposed in which the low frequency tail of the triggering whistler initiates phase trapping of resonant electrons. The correlated x-ray and VLF bursts were observed during the recovery phase of a substorm. Evidence is presented that these emissions were generated on the outer edge of the plasmapause and were seen at Siple as the plasmapause was convected past the Siple field line by a magnetospheric westward electric field. (LBS)

28021 LONGITUDINAL PHOTONS IN PLASMA. Gintsburg, M.A. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio–Wave Propagation, Academy of Sciences of the USSR). Sov. Astron.–AJ 18: No. 1, 128-130 (July 1974).

A finite photon rest mass m_γ might be detectable by measuring whistler time delays or oscillations of trapped magnetospheric particles. If $m_\gamma \neq 0$, cosmic distances $> 10^3$ km will be involved, and Maxwell's equations can be generalized by adding antipotential $(\vec{A}, \varphi)$ terms, with a magnetic photon such that $\vec{H} = \text{grad}\,\vec{\varphi} - \partial\vec{A}/c\partial t$. The dispersion relation for longitudinal photons in plasma is given and their properties are described. Routine worldwide and satellite records of magnetic micropulsations might disclose longitudinal photons in a generalized electric– and magnetic–photon electrodynamics; polarization would be independent of the observer's location. Evidence that $\text{div}\,\vec{H} \neq 0$ for the sum is relevant here. (auth)

28022 FREQUENCY–TIME ANALYSIS OF GEOMAGNETIC BEATING-TYPE PULSATIONS Pc3. Prikner, K.; Strestik, J.; Dobes, K. (Geophysical Inst., Prague). Stud. Geophys. Geod.; 18: No. 3, 266-273(Jul 1974).

The mechanism of beating of Pc3 type pulsations is studied. Using the method of numerical computation of a sonagram (the method of frequency-time analysis) a set of samples of pulsations from the Budkov Observatory is treated (1968–1969) mostly

at K-indices equal to 2–3. By comparing f–t diagrams with the spectra of the samples an attempt has been made at interpreting the beating as a superposition of the frequency components, contained in the pulsation signal. In most observed cases it is possible to determine two close frequencies, the difference of which is on the average $\overline{\Delta f}$ = 5.4 mHz. The average carrier frequency of the samples was $\overline{f}_0$ = 37.6 mHz, and the average frequency of the beating $\overline{f}_B$ = 2.7 mHz. The interval of observed values of f_B amounted to 1–5 mHz. A tendency was observed for f_B to increase with increasing degree of disturbance of the geomagnetic field. (auth)

28023 AMPLITUDE VARIATION OF Pc5 PULSATIONS AT HIGH LATITUDES. Gupta, J. C. (Dept. of Energy, Mines and Resources, Ottawa). Radio Sci.; 9: No. 8-9, 757-768(1974).

Normal-run magnetograms for the year 1967 from seven Canadian observatories were scaled to study the amplitude characteristics of Pc 5 pulsations. The results of the statistical analysis are: (1) Large amplitude Pc 5's occur in a limited region located on the poleward side of the auroral zone. (2) The diurnal variation of Pc 5 amplitude maximizes in the post-noon period at Resolute Bay and this peak tends to appear earlier and earlier in the day at the lower latitude stations, e.g., it appears in the morning at Great Whale River. An additional midnight peak in the diurnal variation of amplitude is noted at auroral zone stations. (3) The amplitude attains a maximum value at Great Whale River near the central line of the auroral zone. It decreases at a faster rate toward the lower latitudes than toward the higher latitudes. In quiet intervals an additional peak in the amplitude-latitude profile is noted near the cusp region at Baker Lake. (4) The diurnal variation pattern of amplitude shows no clear relationship with the seasons or with magnetic activity. (5) Under disturbed magnetic conditions a much larger amplification of the amplitude of PC 5's was at Great Whale River than at high or low latitude stations. PC 5 amplitudes correlate very well with Kp up to a level of 6. (6) With increasing solar elevation angle the region of maximum amplitude of Pc 5 is found to move toward the northern border of the auroral zone. (7) From the data analyzed, amplitudes of Pc 5 do not show a 27-day recurrence tendency. (auth)

28024 HIGH–LATITUDE DAY SIDE ELECTRIC FIELD AND PARTICLE MEASUREMENTS. Maynard, N.C.; Johnstone, A.D. (Goddard Space Flight Center, Greenbelt, Maryland 20771). J. Geophys. Res. 79: No. 22, 3111-3123 (1 Aug 1974).

Two rockets carrying electric field and low–energy particle instrumentation were launched near noon at 80° magnetic latitude. One flight encountered polar cap conditions only, whereas the other traversed part of the polar cusp. Although weak particle precipitation was measured on both flights, bursts of intense magnetosheath–type electron fluxes were detected on the latter. Strong electric fields such as would result from antisunward convection were observed during both flights. The measurements are compared with results obtained by other types of spacecraft and are interpreted in the light of those data. It is concluded that direct access of magnetosheath electrons is very variable and occurs in small regions within a larger overall region. (auth)

28025 FURTHER CHARACTERISTICS OF THE EVENING ENERGETIC ELECTRON DECREASES DURING SUBSTORMS. Lin, C.S. (Physics Department and Geophysics Program, University of Washington, Seattle, Washington 98195); Parks, G.K. J. Geophys. Res. 79: No. 22, 3201-3206 (1 Aug 1974).

This article reports the results of studying the evening energetic electron decreases observed at synchronous altitudes with the use of high–resolution data (25.6–s averages). The high–resolution data show that the evening particle events sometimes undergo rapid time variations, faster than the 6–min time–averaged data previously used by Lezniak and Winckler (1970). Periodic structures of 2– to 12–min period often accompany the evening particle decreases. Interpretation of our observations in terms of enhanced plasma energy density at synchronous altitudes during substorms as evidence by DeForest and McIlwain (1971) and Sharp and Johnson (1972) suggests that such plasma regions are highly nonuniform and turbulent. (auth)

28026 ON THE WESTWARD EXPANSION OF SUBSTORM–CORRELATED PARTICLE PHENOMENA. Kangas, J.; Lukkari, L. (Department of Physics, University of Oulu, Oulu, Finland); Heacock, R.R. J. Geophys. Res. 79: No. 22, 3207-3210 (1 Aug 1974).

Observations of auroral X rays and an IPDP (intervals of pulsations of diminishing periods) event in the evening side of the auroral zone during a weak and isolated substorm are reported and discussed. It is concluded that injections of energetic electrons and protons in the midnight region are closely coupled but that a clear separation of particle fluxes occurs in the evening side. The westward expansion of electron precipitation events is shown to depend on electron energy. An apparently single IPDP event appears to consist of overlapping events that are associated with changes in the proton injection rate near midnight. Changes in proton energy as estimated from time delays from the midnight sector suggest that the frequency shift during the IPDP activity cannot be due solely to energy dispersion of westward drifting protons in the geomagnetic field. (auth)

28027 CONJUGATE AURORAL RADAR OBSERVATIONS OF A SUBSTORM. Ecklund, W.L.; Carter, D.A. (Aeronomy Laboratory, NOAA, Boulder, Colorado 80302); Keys, J.G.; Unwin, R.S. J. Geophys. Res. 79: No. 22, 3211-3214 (1 Aug 1974).

The substorm that occurred shortly after the OOSIK shaped charge barium release from Alaska on March 7, 1972, was observed by magnetically conjugate VHF auroral radars in New Zealand and Alaska. The wide latitudinal coverage of the two radars provided a clear picture of the eastward and westward auroral electrojets in the substorm expansive phase. During this evening period the eastward electrojet was bounded on its poleward edge by visual auroral arcs, and the westward electrojet appeared poleward of these arcs at substorm onset. At onset the southern hemisphere discrete radar aurora was 70 km equatorward of the area calculated to be conjugate to the northern hemisphere activity. (auth)

28028 GROWTH RATES OF THE ION CYCLOTRON INSTABILITY IN THE MAGNETOSPHERE. Märk, E. (Space Plasma Division of the Austrian Academy of Sciences, Institute for Theoretical Physics, Innsbruck, Austria). J. Geophys. Res. 79: No. 22, 3218-3220 (1 Aug 1974).

Growth rates of the ion cyclotron instability in the magnetosphere are calculated, including the corrections coming from finite proton and electron temperatures. The effect of (artificial) injection of cold plasma with different ion masses is discussed in detail. (auth)

28029 ELECTRIC AND MAGNETIC FIELD OBSERVATIONS DURING A SUBSTORM ON FEBRUARY 24, 1970. Gurnett, D.A. (Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa 52242). J. Geophys. Res. 79: No. 22, 3197-3200 (1 Aug 1974).

In this brief note we report a series of electric field measurements obtained from the Injun 5 satellite and simultaneous magnetic disturbances observed in the interplanetary medium and on the ground during a magnetic substorm. The substorm analyzed took place on February 24, 1970. Prior to the onset of the substorm a greatly enhanced antisunward plasma flow was observed over the polar cap. The enhanced plasma flow occurred about 30 min after a switch in the direction of the interplanetary magnetic field from northward to southward. The electric fields across the polar cap immediately before and during the substorm were essentially unchanged, and it is thus indicated that an enhancement in the ionospheric conductivity rather than the electric field must be responsible for the increase in the auroral electrojet current during the substorm. (auth)

28030 CORRELATION OF Kp WITH THE SUBSTORM–INJECTED PLASMA BOUNDARY. Mauk, B.H.; McIlwain, C.E. (Physics Department, University of California, San Diego, La Jolla, California 92037). J. Geophys. Res. 79: No. 22, 3193-3196 (1 Aug 1974).

The local time position of the low–energy substorm–injected plasma boundary in the dusk to midnight region of the magnetosphere as observed by the geostationary satellite ATS 5 is found to be correlated with the interpolated Kp index. Considering the time resolution of Kp the correlation is found to be quite close but dependent on season. An estimate of the overall shape and position of the low–energy boundary within this region of the magnetosphere as a function of Kp is found by using a fit to our winter data correlation in conjunction with a fit of data presented by Carpenter (1967) concerning the Kp–related radial positioning of the plasmapause boundary in the postmidnight region. This analysis results in a spiral structure, the scale of which depends on Kp. (auth)

28031 EVIDENCE FOR THE RESONANCE PRECIPITATION OF ENERGETIC ELECTRONS FROM THE SLOT REGION OF THE RADIATION BELTS. Imhof, W.L.; Gaines, E.E.; Reagan, J.B. (Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). J. Geophys. Res. 79: No. 22, 3141-3146 (1 Aug 1974).

An investigation is made of the energy spectra of energetic electrons precipitating from the slot region between the inner and outer radiation zones ($L \simeq 2$ to $\simeq 3.5$). This represents an extension of a previous study in which we reported the discovery of peaks (having strongly L–dependent central energies) often occurring in the spectra of electrons precipitating from the outer edge ($L \simeq 1.4$ to $\simeq 1.8$) of the inner radiation zone. Quasi–trapped electrons ($h_{min} < 0$) are often observed to have exponential spectral shapes in the slot region, but a variety of other spectral shapes can also occur. On certain passes, L-dependent peaks are found in the spectra of the precipitating electrons. However, the peaks are generally broader and less pronounced than those found at the outer edge of the inner belt. In the slot region up to $L \simeq 3.5$ the dependences of the central energies of the peaks upon L, on a given satellite pass are generally consistent with the energy variations calculated for first–order cyclotron resonance at the

equator with waves of a constant frequency in the range of a few hundred hertz to about 2 kHz propagating parallel to the magnetic field. This frequency band is consistent with the measurements by Thorne et al. (1973) of plasmaspheric hiss occurring over a broad range of L shells throughout the plasmasphere. Within the limits of available data on equatorial electron densities the frequencies required for cyclotron resonance can be put into agreement with the wave band assumed by Lyons et al. (1972) to account for the high electron loss rates in the slot region. (auth)

28032 THE DISCOVERY OF ENERGETIC He^+ IONS IN THE MAGNETOSPHERE. Johnson, R.G.; Sharp, R.D.; Shelley, E.G. (Lockheed Palo Alto Research Laboratory, Lockheed Missiles and Space Company, Inc.,Palo Alto, California 94304). J. Geophys. Res. 79: No. 22, 3135-3140 (1 Aug 1974).

The presence of He^+ ions with energies up to 1.4 keV has been detected on two occasions by energetic ions mass spectrometer experiments on the low-altitude polar satellites 1969-25B and 1971-089A. The peak energy flux of the He^+ ions was 0.03 erg/cm^2 s sr and occurred at L = 7 and a magnetic local time of 07 hours. The He^+ ions were accompained by protons in the same energy range and O^- ions of somewhat higher energies. No He^{++} ions were observed on either occasion. In one event the He^+ and O^+ ions are shown to have similar velocity spectrums. It is concluded that the He^+ is most likely of ionospheric origin, perhaps accelerated by the same mechanism that accelerates the O^+. (auth)

28033 WAVE AND PARTICLE MEASUREMENTS AT THE POLAR CUSP. D'Angelo, N.; Bahnsen, A. (Danish Space Research Institute, Lyngby, Denmark); Rosenbauer, H. J. Geophys. Res. 79: No. 22, 3129-3134 (1 Aug 1974).

Measurements of magnetic field fluctuations and low-energy particles at several Heos 2 polar cusp crossing are described. A possible source of the fluctuations appears to be a Kelvin-Helmholtz instability excited at the cusp boundaries by velocity shear in the ion flow. The relevance of this instability to certain properties of the cusp region is discussed. (auth)

28034 NONLINEAR CANALIZATION OF WHISTLE-TYPE (VLF) WAVES IN THE MAGNETOSPHERE. Molchanov, O. A.; Trakhtengerts, V. Yu.; Chmyrev, V. M. (Inst. of Earth Magnetism, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 3, 325-332(1974). (In Russian).

It is shown that the whistle-type waves in the magnetosphere may be canalized along forced lines of the magnetic field of the Earth due to the nonlinear interaction between electrostatic oscillations (decay interaction) and thermal plasma particles (induced scattering). Estimations of the characteristic time of interactions are presented. A mechanism of canalization is described for the interaction between whistle-type and ion-cyclotron waves. (auth)

28035 MEASUREMENT OF THE DIFFERENTIAL PROTON ENERGY SPECTRUM IN SPACE. Kovtyukh, A. S.; Panasyuk, M. I.; Reizman, S. Ya.; Sosnovets, E. N. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 6, 797-802(1973).

Translated from Kosm. Issled.; 11: No. 6, 883-889(1973).

A discussion is given of the extent to which the energy resolution and differential channel width of a spectrometer utilizing a semiconductor detector will influence the accuracy of direct measurements of proton spectra in space. The dependence of the readings of a multichannel differential spectrometer on the channel width is analyzed for various types of the initial radiation spectrum. One should also take into account and make an optimum choice of such parameters of the spectrometer as the resolution and channel width when recording a proton component with varying spectral characteristics. (auth)

28036 ENERGY DENSITY OF CHARGED PARTICLES RECORDED IN OPEN DRIFT SHELLS AT ALTITUDES OF ~300 km. Tsaplin, V. S.; Shavrin, P. I.; Gribkov, V. M. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 6, 792-796(1973).

Translated from Kosm. Issled.; 11: No. 6, 878-882(1973).

Based on the measurement results of proton and electron spectra in open drift shells at $L \gtrsim 1$ to 4, their energy density is calculated as $\epsilon_{o.d.s.} \approx 0.60$ eV/cm^3. The result obtained permits the statement to be made that soft protons ($1\ MeV \gtrsim E_p \gtrsim 4$ MeV) are associated with the effect of the earth's radiation belts; protons formed by the hard part of the spectrum have an albedo origin. An estimate is given of the total energy of charged particles in open drift shells. (auth)

28037 CAPTURE OF ULTRARELATIVISTIC ELECTRONS BY A MAGNETIC DIPOLE. Morozov, D. Kh.; Shlapak, V. N. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 6, 784-791(1973).

Translated from Kosm. Issled.; 11: No. 6, 870-877(1973).

The motion of ultrarelativistic electrons in the equatorial plane of a geomagnetic dipole is discussed, including the energy loss to magnetic bremsstrahlung radiation. It is shown that as a result of the energy loss, electrons will be captured. The comparatively low-energy part of the spectrum of captured electrons has the form AE^{-2}. If the spectrum of the primary flux is approximated by the power function $E^{-2.5}$, then for energies not too close to the initial value the intensity of captured electrons rises practically linearly with the distance of the observation point from the dipole. The analysis makes use of the methods of perturbation theory. It is shown that the particles entering the portion of phase space where perturbation theory is inapplicable give a negligibly small contribution to the flux. The screening effect of the earth is also taken into account. (auth)

28038 STIMULATED AMPLIFICATION OF ULF WAVES BY MAGNETOSPHERIC INJECTIONS OF PLASMA CLOUDS AND PARTICLE BEAMS. Liemohn, H. B. (Battelle-Pacific Northwest Labs., Richland, WA). Radio Sci.; 9: No. 7, 683-695(Jul 1974).

Understanding of wave particle interactions in the magnetosphere has progressed to the point where it may be possible to stimulate wave amplification at ULF (about 0.1 to 10 Hz) by disturbing the cyclotron resonance conditions through catalytic injections of plasma clouds or particle beams. Modification of the interaction can be achieved by the introduction of localized clouds of plasma that reduce the phase velocity of the waves and cause enhanced amplification by lowering the resonance velocity. Alternatively, direct injection of hot energetic particle beams can also appreciably alter the local amplification characteristics. Different methods for injecting clouds of lithium plasma and proton beams have been modeled quantitatively to assess their relative merits. Amplifications of many tens of decibels appear to be feasible with lithium clouds of only 1 to 2 kg of material. With present technology the beam diameter from a conventional particle gun on board a satellite or rocket is too small for an effective interaction, but appreciable amplification is indicated. Such a prospect has great significance. First, it offers a direct test of the fundamental physical processes that are believed to control the state of the magnetosphere. Second, controlled injections might be used to stimulate artificial amplification of ULF emissions on command and allow them to be used as a wide-area communication system. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstract 27600.

28039 (JINR-P7-7999) PRODUCTION OF CARBON AND NITROGEN NUCLEI OF MULTICHARGED ARGON AND XENON IONS IN THE ELECTRON BEAM ION SOURCE. Donets, E. D.; Pikin, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

In the electron beam multicharged ion source with a superconductive solenoid the product of electron flux density and electron-ion interaction time about 1.10^{19} cm^{-2} at the electron energy of 2.5 keV was realized. The beams of carbon ($_6C^{+6}$) and nitrogen ($_7N^{+7}$) nuclei as well as of argon ($_{14}A^{+14}$) and xenon ($_{51}Xe^{+29}$) ions were produced. Preliminary experimental data on sequential ionization cross sections of positive ions of the above-mentioned chemical elements were obtained. (auth)

28040 FOCUSING OF ELECTRON TUBE BEAMS WITH COMPENSATION OF INITIAL MAGNETIC CURRENT. Alferova, E. V. Tr. Mosk. Energ. Inst., Fiz.; No. 144, 142-148(1972). (In Russian).

Trajectory analysis verified predictions from curves of vector-potential vs. resistance that the use of a compensating coil with a radius greater than the average radius of the emerging beam should more nearly compensate the current at the cathode. Compensation is best when the coil is at a specified distance from the cathode plane. Among other factors that affect the focusing of a wide beam are the dimensions of the coil. With proper choice of coil and conditions, a narrow beam–a factor of 2 to 4 smaller than the emerging beam, can be obtained. (TTT)

28041 CHEMICAL ACCELERATOR FOR PRODUCING A VARIABLE ENERGY NEUTRAL MOLECULAR BEAM: TOTAL CROSS SECTIONS FOR SF_6 ON H_2, He, CO_2, AND SF_6. Greene, D. B. Tallahassee, FL; Florida State Univ. (1974). 121p. University Microfilms Order No. 74-18,073.

Thesis (Ph. D.).

A chemical accelerator was constructed in which a focused, variable energy, neutral particle beam of SF_6 is formed, passed through a scattering cell, and total cross sections measured. The neutral beam is formed by first producing in the source the temporary negative ion SF_6^- and then accelerating to the desired energy. The SF_6^- has a lifetime of approximately 25 μsec after which the electron autoejects, returning the SF_6^- to its neutral state. This neutral beam of large molecules is then used to perform attenuation experiments for the measurement of total cross sections. The collision system has a 0.025 mm slit at the source. The scattering cell and detector had 0.076 mm and 0.178 mm slits located at 1.9 m and 4.6 m from the source. The scattering cell was 6.2 cm long. A particle multiplier was used to detect the beam, which had an intensity of approximately 30 particles per second with no background. The total cross section data were fit to the theoretical cross section model $\sigma = d^2(1 - E_0/E)$, where d is the interaction diameter for collisions, E_0 is the threshold interaction energy and E is the lab energy, which ranged from 900 eV to 1500 eV. The fitting of the data to this curve resulted in the following values for d and E_0: $SF_6 + H_2 - d = 5.4 \pm 0.6$ Å, $E_0 = 447.7 \pm 152.8$ eV; $SF_6 + He - d = 5.7 \pm 0.5$ Å, $E_0 = 475.1 + 133.2$ eV; $SF_6 + CO_2 - d = 5.6 \pm 0.5$ Å, $E_0 = 475.9 \pm 125.7$ eV; $SF_6 + SF_6 - d = 6.5 \pm 0.7$ Å, $E_0 = 484.4 \pm 150.7$ eV. The χ^2 value in each case indicated that the model gave a good fit to the data. (Diss. Abstr. Int., B)

28042 AUGER ELECTRON SPECTROSCOPIC INVESTIGATIONS OF CHEMICAL SHIFTS IN SOME VANADIUM COMPOUNDS. Szalkowski, F.J. (Science Center, Rockwell International, Thousand Oaks, California 91360); Somorjai, G.A. J. Chem. Phys. 61: No. 5, 2064-2070 (1 Sept 1974).

The Auger spectra of vanadium metal and of the compounds V_2O_3, V_2O_5, VO, VN, VC, V_2S_3, and VSi_2 have been observed. Shifts in energy of the vanadium $L_3M_{2,3}M_{2,3}$ inner–shell Auger transition peak as the result of chemical bonding effects have been measured. These shifts have been found to be related to the chemical bond ionicity as determined by the Philips–Van Vechten ionicity scale. The ratio of the anion to cation Auger peak intensities observed for the compounds can also be utilized in the determination of the surface composition. (auth)

28043 SCATTERING OF He AND Ne ATOMS FROM A (001) SURFACE OF SODIUM FLUORIDE. Wood, B.; Mason, B.F.; Williams, B.R. (Radio and Electrical Engineering Section, National Research Council of Canada, Ottawa, Canada K1A 0R8). J. Chem. Phys. 61: No. 4, 1435-1454 (15 Aug 1974).

The scattering of He and Ne atoms from a cleaved (001) surface of NaF has been studied at different surface temperatures and incident beam energies. The geometric peak shape expected for the beam detector arrangement was compared to the experimentally observed peaks under different conditions of surface temperature and incident energy. The (00) peak height was followed as a function of surface temperature for two values of the incident momentum, in order to extract some information about the role of the attractive part of the interaction potential during a collision. Finally, the peak heights of several diffraction peaks were determined as a function of the incident energy. Several minima were observed in the scattering pattern, which can be associated with bound state resonances and which have been the subject of considerable interest recently. In this case, several maxima were found which can also be associated with bound state resonances. The (00) peak, observed in the scattering of Ne atoms, also showed maxima and minima when the height was monitored, as a function of the incident energy. (auth)

28044 PULSED CHARGE-EXCHANGE SOURCE OF NEGATIVE HYDROGEN IONS. Dimov, G. I.; Roslyakov, G. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 1, 22-28(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 1, 29-36(1974).

A description is given of a charge-exchange source of H^- ions having a current of up to 54 mA in a pulse having a length of 100 μ sec. The normalized emittance of the beam is 0.2 mrad · cm × 0.025 mrad · cm. Results are presented of an investigation of an arc plasma source, a multicell grid system for extracting protons from the plasma and for defining a beam with charge exchange in hydrogen. The protons are extracted with a transverse temperature ~ 0.25 eV, and the proton current ranges up to 3 A. Up to 92% of the protons pass through a louvered extracting grid beyond which their space charge is compensated by electrons. The exit of H^- ions from the charge-exchange target reaches 90% of the expected value. The scattering in the target does not make a noticeable contribution to the angular scatter which is basically obtained due to passage through the louvered grid. (auth)

28045 THEORETICAL INVESTIGATION OF THE CATHODE SPUTTERING PHENOMENON. Badawy, Y. K. M.; Rizk, A. J. Natur. Sci. Math.; 12: No. 2, 197-209(Oct 1972).

The mechanism of the cathode sputtering phenomenon is investigated by means of a phenomenological model based on the momentum transfer theory. The basic features of the model incorporate the interaction mechanisms of a sound wave packet with an internal atom of the cathode and the transfer of a reflected momentum to a surface atom to cause its sputtering. It is shown that this model leads directly to Wehner's sputtering formula. (auth)

28046 MOLECULAR BEAM DETECTION USING ELECTRON IMPACT IONIZATION. Wynter, A. P.; Hasted, J. B. (Birkbeck Coll., London). J. Phys., E (London); 7: No. 8, 627-634(Aug 1974).

Measurements of the ionization efficiency of an inverted cylindrical triode electrom impact ionizer were made on a fast atomic hydrogen beam (650 to 1250 eV), and are compared with a theory which postulates electron oscillations, which are treated on the assumption that the axial wire anode possesses calculable transmission factor. The electron space-charge configuration and its effect on the paths of the ions are treated quantitatively. The ionization efficiency is relatively low: 3.5×10^{-6} for 1250 eV beams falling to 1×10^{-6} for 650 eV beams, with anode currents 6 mA, grid current 60 mA, grid and anode potentials both 200 V with respect to the cathode. The calculated ionization efficiencies agree within 20% with the experimental values, over a range of anode current 2 to 6 mA. The decrease of ionization efficiency with decreasing beam energy is explained as being primarily due to the ion-optical effect of the electron space-charge potential well. The ions formed in this well not only experience focusing, but in climbing out, suffer an energy defect. Energy analysis shows this to be proportional to ionizing current, 43 eV at 250 mA; the calculated value is 35 eV. (auth)

28047 INTENSITY DISTRIBUTION OF FAST POSITIVE AND NEGATIVE PARTICLES IN THIN CRYSTALS. Kudrin, V. V.; Vorobiev, S. A. (Tomsk Polytechnic Inst., USSR). Radiat. Eff.; 21: No. 3, 145-149(Mar 1974).

The intensity distribution of 1 MeV positrons and electrons scattered by the single atomic row and in the three-dimensional Au structure are calculated with the use of the classical model of

binary collisions. The main features of the motions of the positively and negatively charged particles are discussed in terms of the continuum approximation of particle channelling. For the positively charged particles the qualitative agreement with the experimental data was achieved. For the motion of the negatively charged particles in the crystal lattice the lack of the statistical randomization of the transverse momentum vector was demonstrated. (auth)

28048 NON-LINEAR THEORY OF MICROWAVE-OSCILLATORS BASED ON INDUCED CHERENKOV RADIATION FROM RELATIVISTIC ELECTRON FLUXES. Krotova, Z. N.; Chertkov, Yu. S. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 3, 413-415 (1974). (In Russian).

This study contains results of calculations to find optimum parameters of microwave generators, as the electron energy changes from weakly relativistic to ultrarelativistic values. An expression is given for the efficiency of interaction of the electron flux with a wave of constant amplitude and phase velocity. The maximum efficiency is presented graphically as a function of the electron energy. (SJR)

28049 MULTIPHOTON EXCITATION OF HYDROGEN MOLECULE IN AN INTENSE LASER BEAM. Devi, U.; Acharya, R.; Mohan, M. (Delhi Univ. (India). Dept. of Physics and Astrophysics). Phys. Lett., A; 48: No. 3, 207-208(17 Jun 1974).

The transition probability for the multiphoton excitation of molecular hydrogen due to an intense electromagnetic field has been calculated by a recent method of Reiss. Intensity dependence of the transition probability has been numerically investigated. (auth)

28050 EXTENDED WORKING RANGE FOR ELECTRON BEAMS IN ATMOSPHERE. I. Theoretical Calculations. Smith, R. C.; Schumacher, B. W. (Westinghouse Research Labs., Pittsburgh, Pa. (USA)). Nucl. Instrum. Methods; 118: No. 1, 73-91 (1 Jun 1974).

For cutting and welding with an electron beam in air at atmospheric pressure the scatter broadening of the beam diminishes the available beam power density rapidly. Based on well-established, single-scattering theory and a Monte-Carlo simulation of multiple scattering, quantitative data were derived for the scatter-broadening as well as the retained peak power density in air, helium, and hydrogen at different temperatures as well as for the mixture of gases in a hydrogen/oxygen flame. It was shown that in hot helium (at 1 atm of pressure) the power density at any distance is nearly one hundred times higher than in air of room temperature. Thus, a flame with admixed helium can be used to extend the working range for such beams significantly. When the results of the Monte-Carlo calculation are compared with predictions of the older scattering theories, it is found that the older theories do not properly account for the beam shape and give values for the peak current density which are too low, up to factors of two. (auth)

28051 BEAM FORMATION IN A TRIODE ION GUN. Wittmaack, K. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg; Muenchen (F.R. Germany). Physikalisch-Technische Abt.). Nucl. Instrum. Methods; 118: No. 1, 99-113 (1 Jun 1974).

Beam formation in a triode ion gun has been investigated. The gun consisted of a plasma ion source operated with argon, a low-potential cup extractor and an acceleration tube (diameter D). The ion optics of the system were studied by recording the current density profile of focussed 40 keV beams with the beam current as a parameter. Currents up to about 200 μA were obtained by increasing the plasma density in the ion source. Focussing was achieved by suitably adjusting the extractor potential. To get a comprehensive view of beam formation the following gun parameters were varied: extraction-gap distance ($0.5 \le d \le 7$ mm, adjustable in situ), extractor length ($0.59 \le L/D \le 1.65$), acceleration-gap distance ($0.05 \le g/D \le 0.8$), length of ion-source outlet ($0.1 \le l \le 1$ mm), diameter of extractor entrance opening ($2.5 \le b \le 5$ mm) and monitor position ($z = 28$ and 70 cm from the midplane between the electrodes). The focussing extractor voltage was found to increase linearly with increasing extractor length for $L/D \ge 1$. A minimum extractor voltage of only 150 V was observed at $L/D = 0.7$. The beam profiles at $z = 70$ cm were found to be broadened markedly by space-charge expansion in the field-free drift region. The influence of extraction-gap distance and extractor length was much less pronounced. Profile distortions observed under well-defined conditions at either low or high beam currents were found to be due to a particular shape of the plasma boundary or strong beam divergence in the extraction region, respectively. The divergence of beams from convex plasma boundaries could be described quantitatively by applying the space-charge law between concentric spherical electrodes. The width of the profiles at $z = 28$ cm could be interpreted using standard beam-transport theory. Combined profile measurements at either monitor position provided an estimate of the beam emittance. Using recently reported properties of a two-tube electrostatic lens a self-consistent picture of beam formation in the triode ion gun could finally be obtained. (auth)

28052 BACKSCATTERING OF POSITRONS FROM THICK TARGETS. Kuzminikh, V. A.; Tsekhanovski, I. A.; Vorobiev, S. A. (Tomskij Politekhnicheskij Inst. (USSR)). Nucl. Instrum. Methods; 118: No. 1, 269-271(1 Jun 1974).

The empirical equation for the backscattering coefficient of monoenergetic positrons impinging normally on thick targets is found. This equation is expressed by the $\eta(Z,T)$ function of the target atomic number for $6 \le Z \le 79$ in the energy region from 0.1 to 20 MeV. The values of $\eta(Z,T)$ are found by computer calculation with the use of the "segment model", which was verified by comparison with the experimental data for electrons. The calculated backscattering coefficients of electrons and positrons show a significant difference, especially in the high-energy region and for high-Z materials. (auth)

28053 AN EMPIRICAL RELATIONSHIP BETWEEN ATOMS AND IONS SPUTTERED FROM SINGLE CRYSTAL SURFACES. MacDonald, R. J. (Australian National Univ., Canberra. General Studies Dept. of Physics). Surface Sci.; 43: No. 2, 653-656(Jun 1974).

Many of the sputtered atoms, ejected on ion bombardment of the surface, will be in excited states. It is shown that the probability of escape in an excited state, $\alpha(E)$, equals the probability that the excited atom decays into an ion, $\eta(E)$. This empirically derived relationship, $\eta(E) = \alpha(E)$, is shown to hold for Cu^+ ions sputtered from Cu by Ar ions. (NL)

28054 LOW-ENERGY DUOPIGATRON SOURCE WITH AN AUXILIARY GAS FEED. Hurley, R. E. (Edwards High Vacuum Ltd., Crawley (UK)). Nucl. Instrum. Methods; 118: No. 1, 307-310(1 Jun 1974).

Measurements of beam divergence, emittance and current extracted from a small-scale reflex arc source are described. The source is found suitable for applications involving collision studies, sputtering and implantation. (auth)

Atomic and Molecular Properties

Refer also to abstract 27440, 27541, 28125, 28517, and 28525.

28055 CORRELATED WAVEFUNCTIONS, ENERGIES, AND ONE-ELECTRON RADIAL DENSITIES FOR S STATES OF THE He ATOM. Winkler, P.; Porter, R.N. (Department of Chemistry, State University of New York, Stony Brook, New York 11790). J. Chem. Phys. 61: No. 5, 2038-2046 (1 Sept 1974).

A priori approximation of integral-transform wavefunctions by Gauss quadrature provides an efficient and simple method for obtaining a finite approximation to the complete set of eigenfunctions of the Hamiltonian of a two-electron atom. These functions are described, and the energies and one-electron radial densities of the lower-lying S states of the He atom and the ground state of H^- are given. The energies are close to the exact values obtained from conventional variational results with Hylleraas-type functions extrapolated to the limit of an infinity of terms. The one-electron radial densities of the S states of He are found to have n-2 pseudonodes, where n is the principal quantum number, the triplet-state pseudonodes lying slightly closer to the origin than those of the corresponding singlet states. (auth)

28056 GAUSSIAN BASIS CONFIGURATION INTERACTION CALCULATIONS ON TWENTY ELECTRONIC STATES OF H^+_3. A BOUND $^3\Sigma^+_u$ EXCITED LEVEL. Schaad, L.J.; Hicks, W.V. (Chemistry Department, Vanderbilt University, Nashville, Tennessee 37235). J. Chem. Phys. 61: No. 5, 1934-1942 (1 Sept 1974).

Configuration interaction calculations with a Gaussian basis were carried out on the lowest five states of each symmetry $^1A'$, $^3A'$, $^1A''$, and $^3A''$ for H^+_3. All geometries with bond lengths between 1.2 and 3.6 a.u. were examined. Other than the ground state, only the $1\,^3A''$ surface contained a stable state. This is a linear symmetric $^3\Sigma^+_u$ level with energy equal -1.11422 a.u. and bond lengths of 2.457 a.u. It is stable by only 6.47 kcal/mole with respect to dissociation to H^+_2 $(X^2\Sigma^+_g)+H(1s)$. The state is computed to have vibrational frequencies of 1191 cm^{-1} (symmetric stretch), 683 cm^{-1} (asymmetric stretch), and 775 cm^{-1} (degenerate bend). (auth)

28057 SINGLET-TRIPLET ANTICROSSINGS IN H_2. Miller, T.A.; Freund, R.S. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Chem. Phys. 61: No. 5, 2160-2162 (1 Sept 1974).

Accurate values for the absolute energies of triplet states for H_2 are unavailable because no singlet-triplet intercombination in H_2 has been reported. The singlet-triplet separation has now been measured by the

technique of level anticrossing, wherein two levels are tuned to near degeneracy by an external magnetic field. (AIP)

28058 EXACT GROUND AND EXCITED STATE SECOND-ORDER PROPERTIES OF THE HYDROGEN ATOM. I. POLARIZABILITIES. Laurenzi, B.J.; Williams, D.G.; Bhatia, G.S. (Department of Chemistry, State University of New York at Albany, Albany, New York 12203). J. Chem. Phys. 61: No. 5, 2077-2080 (1 Sept 1974).

Using the exact generalized Green's functions for the first three energy levels of the hydrogen atom, we have computed the static dipole polarizabilities for the S states. The calculations were done analytically and exactly on a digital computer using the list-processing language LISP. (auth)

28059 REMARKS CONCERNING A MODEL FIELD THEORY SUGGESTED BY QUANTUM ELECTRODYNAMICS IN A STRONG ELECTRIC FIELD. Fulcher, L. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Klein, A. Ann. Phys. (N.Y.); 84: No. 1, 335-347(15 May 1974).

For a nucleus of atomic number $Z \sim 170$, it has been shown recently that the state of the bare nucleus, usually defined to be the vacuum state of the field theory, becomes unstable against the emission of a pair of positrons. The essential mathematical physics of this situation is contained in a simple reduced Hamiltonian, which has been previously studied by others. The present note is a synopsis for which novelty is claimed only in some details and viewpoints. (auth)

28060 MULTIPHOTON IONIZATION OF HIGHLY EXCITED HYDROGEN ATOMS. Bayfield, J.E.; Koch, P.M. (J. W. Gibbs Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. Lett. 33: No. 5, 258-261 (29 July 1974).

A new method for the experimental study of multiphoton processes uses production of highly excited atoms in keV electron-transfer collisions. Such atoms can be ionized over a wide range of frequencies of an external electromagnetic field, permitting studies of multiphoton-ionization processes for regimes not yet achieved in laser experiments. Results for microwave ionization of hydrogen atoms with principal quantum numbers in the band $63 \leqslant n \leqslant 69$ are discussed in terms of the available theory. (auth)

28061 NEW ROTATIONAL TRANSITION IN THE HYDROGEN MOLECULE. Gibbs, P.W.; Gray, C.G.; Hunt, J.L. (Department of Physics, University of Guelph, Guelph, Ontario, Canada); Paddi Reddy, S.; Tipping, R.H.; Chang, K.S. Phys. Rev. Lett. 33: No. 5, 256-258 (29 July 1974).

Pressure-induced rotational-vibrational U transitions ($\Delta J = 4$) of hydrogen gas have been observed for the first time at 195 K for densities in the range 180-300 amagat. The spectrum is interpreted in terms of a hexadecapolar induction mechanism, and from the experimental integrated absorption coefficient of the U(1) line, rough values are obtained for the hydrogen-molecule hexadecapolar moment and its derivative. (auth)

28062 MECHANISM OF POPULATION INVERSION IN ATOMIC HYDROGEN. Aleinikov, V.S.; Shelepo, A.P. Opt. Spectrosc. (USSR) 36: No. 4, 474-475 (Apr 1974).

Optical laser action in the spectrum of atomic hydrogen is studied and the mechanism of population inversion is described. (AIP)

28063 POLARIZABILITY OF A RELATIVISTIC HYDROGEN ATOM. Shestakov, A.F.; Khristenko, S.V. Opt. Spectrosc. (USSR) 36: No. 4, 369-370 (Apr 1974).

The static polarizability of a relativistic hydrogen atom in the ground state is presented in closed analytical form. Calculations consist of expansions of the relativistic Coulomb Green's function by Sturm functions of linear and quadratic Dirac equations. Numerical values of relativistic polarizability are given for different nuclear charges. The lead term $\sim (z\alpha)^2$ in the expansion for relativistic correction coincides with those found in the work of Bartlett and Power [J. Phys. A2, 419 (1969)]. (auth)

28064 THE EFFECT OF 4f ELECTRONS ON THE STRUCTURE OF X-RAY SPECTRA. Demekhin; Poltinnikova, T.M. Opt. Spectrosc. (USSR) 36: No. 4, 386-388 (Apr 1974).

A calculation of the multiplet structure that develops in the $2p^5 4f^n \rightarrow 4d^9 4f^n$ emission transitions has been carried out using intermediate coupling for Gd, Tm and Yb. The computations were also done for the $2s^1 4f^n \rightarrow 4p^5 4f^n$ transitions in Ce and Gd as well as for $3d^{10} 4f^7 \rightarrow 3d^9 4f^8$ absorption in Gd. The results of the calculations are in good agreement with experiment. It was shown that the probabilities of 4p→2s and 4d→2p transitions with the ejection of one of the 5s or 5p electrons are too small to make an appreciable contribution to the long-wavelength structure of the emission bands. (auth)

28065 He-$He^1\Sigma^+$ POTENTIAL: COUPLING BETWEEN INTER-ATOMIC AND INTRA-ATOMIC CORRELATION IN THE AB INITIO COUPLED-PAIR MANY ELECTRON THEORY CALCULATION. Salahub, D. R. (Univ. of Waterloo, Ont.). Mol. Phys.; 28: No. 1, 243-248(Jul 1974).

Results of CPMET (coupled pair many electron theory) calculations on the He-He potential are presented. The effect of inter-intra coupling is shown to be far more negligible (about 30% of the binding energy). Since the coupling must vanish with increasing R the previous striking agreement between experiment and ab initio calculations must be regarded as somewhat fortuitous. This is likely to be a principal reason for the present disagreement between ab initio and perturbation theoretical values for the long-range interatomic energy constants. (auth)

28066 THREE-PARAMETER WAVEFUNCTION FOR THE HYDROGEN MOLECULE. Leclerc, J. C. (Univ., Liege). J. Phys., B (London); 7: No. 9, L281-L283(21 Jun 1974).

The elaborated Guillemin-Zener function: $\psi = (1 + \rho R\ \xi)\ \exp(-\alpha R\ \xi \pm \beta R\eta)$ is investigated as a nonstandard basis function for approximating the ground state wave function of the hydrogen molecule using numerical integration. A significant improvement on total energy is reached compared to the traditional Slater type orbital, except if noninteger values are allowed for n quantum number in the latter. (auth)

28067 EXPERIMENTAL STUDY OF STARK BROADENING OF THE ALLOWED AND FORBIDDEN TRANSITIONS 2^3P-4^3D, 4^3F (λ = 4,471.5 A, λ = 4,470 A) IN NEUTRAL HELIUM. Darwin, H. W.; Ramette, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de la Physique du Plasma et de la Fusion Controlee). Z. Naturforsch., a; 29: No. 6, 838-850(Jun 1974).

Measurements were made of the profile of the HeI 4,471.5 A line and its forbidden component at λ = 4,469.9 A, emitted from an afterglow plasma of electron densities in the range 2.2×10^{14} to 1.5×10^{15} cm^{-3}. The various quantities which define position and form of the profile have been compared with the theoretical calculations of Griem and of Barnard et al. It has been found that the wavelength shifts of the individual components and, thus, the peak separation are slightly smaller than predicted by theory, whereas the intensity in the valley between the two components is found to be slightly larger than the theoretical values. The peak intensity of the forbidden component is smaller than given by theory. At low electron densities the intensity of the forbidden component is proportional to the square of the normal field strength F_0 of the electric microfield. At higher electron densities the intensity increases proportionally to F_0 in agreement with the transition from quadratic to linear Stark effect a higher electric field strengths. The measurements show that the influence of the ion dynamics on the line profile is probably not as large as assumed by D. D. Burgess, and that the position of the intensity minimum between allowed and forbidden component is shifted towards the allowed component when the temperature decreases. (auth)

28068 EXCITATION OF THE ^{2}3S, ^{3}3S, AND ^{4}3S STATES IN HELIUM BY ELECTRON IMPACT. Mathur, K. C.; Rudge, M. R. H. (Queen's Univ., Belfast). J. Phys., B (London); 7: No. 9, 1033-1041(21 Jun 1974).

A new plane wave approximation for calculating exchange scattering amplitudes is described and applied to the calculation of some singlet-triplet cross sections in helium. Comparison is made with experimental measurements of both total and differential cross sections. It is shown that a considerable improvement over previous techniques is obtained but that there remain significant differences between the theory presented and experimental measurement. (auth)

28069 TWO-PHOTON IONIZATION OF H_2^+. Davydkin, V. A.; Rapoport, L. P. (Voronezh State Univ., USSR). J. Phys., B (London); 7: No. 9, 1101-1108(21 Jun 1974).

Two-photon ionization of diatomic molecules is discussed taking as an example the hydrogen molecular ion. The Green's function in spheroidal coordinates is obtained for the quantum defect method. The total cross section and angular distribution coefficients of the ejected electrons are computed for two-photon ionization of H_2^+ in the ground state at the equilibrium internuclear distance. A frequency range up to first resonance is covered. The cases of linear and circular polarization of the absorbed photons are investigated. (auth)

28070 RELATIVISTIC ELECTROMAGNETIC SUSCEPTIBILITIES OF HYDROGEN-LIKE ATOMS. Manakov, N. L.; Rapoport, L. P.; Zapryagaev, S. A. (Voronezh State Univ., USSR). Phys., B (London); 7: No. 9, 1076-1082(21 Jun 1974).

Electric and magnetic susceptibilities are calculated in relativistic theory for hydrogen-like atoms. The results are the combination of the hypergeometrical function ${}_3F_2$ with the unit argument. The case of small αZ is investigated. The method of Green's function isused in the calculations. (auth)

28071 1s–3d EXCITATION OF ATOMIC HYDROGEN BY PROTON AND α-PARTICLE IMPACT. Chaudhuri, J.; Bhattacharya, D. M.; Sil, N.C. (Indian Association for Cultivation of Science, Calcutta). J. Phys., B (London); 7: No. 9, 1027-1032 (21 Jun 1974).

The cross section for the collision processes $H(1s) + H^+(He^{2+}) \rightarrow H(3d) + H^+(He^{2+})$ are evaluated using the distortion approximation of H^+ energies between 10 keV to 2000 keV (or He^{2+} energies between 50 keV to 2000 keV). A comparison was made with the corresponding results obtained using the first Born approximation and the Glauber approximation. (auth)

28072 MAGNETIC EFFECTS AT HIGH QUANTUM NUMBERS. Connerde, J. P. (Imperial Coll. of Science and Tech., London). Proc. Roy. Soc. (London), Ser. A; 339: No. 1616, 127-132(23 Jul 1974).

An extended Bohr model is proposed, incorporating Landau's quantization for the treatment of magnetic splittings of atomic levels at high quantum numbers. The results agree well with the splittings observed by Garton and Tomkins (Astrophys. J.; 158: 839 (1969)) in the $6s^2\ ^1S_0$-$6snp\ ^1P_1^\circ$ series of Ba I for values of n up to 32, and qualitatively up to n = 40. (auth)

28073 POSSIBLE EXISTANCE OF A LONG-LIVED DOUBLET STATE OF He^-. Pedersen, E. H.; Simpson, F. R.; Hvelplund, P. (Aarhus Univ., Denmark). J. Phys., B (London); 7: No. 9, L294-L296(21 Jun 1974).

The metastable fraction of a He beam produced by electric-field detachment from He^- ions was measured by the beam-attenuation technique in the energy range from 20 to 700 keV. It is shown that H_2 as an attenuation gas gives the correct metastable fraction. The data further suggest the existence of a long-lived (~10 μs) bound doublet state of He^-. (auth)

28074 NEW RECURRENCE RELATION FOR HYDROGENIC RADIAL MATRIX ELEMENTS. Blanchard, P. (Tufts Univ., Medford, MA). J. Phys., B (London); 7: No. 9, 993-1005(21 Jun 1974).

A recurrence relation is presented which connects the general $(n' \neq n)$ hydrogenic radial matrix element of r^β, where β is a complex number, to matrix elements involving exponents $\beta + 2$, $\beta - 1$, and $\beta - 2$ but the same sets of quantum numbers. This identity is found solely from the boundary conditions on the wave functions and the total radial differential equation and should be of use in simplifying r^k forms given elsewhere. For $n' = n$, the recurrence relation reveals a proportionality between the $-\beta - 2$, $\beta - 1$ matrix elements that includes the Pasternack-Sternheimer identity as a special case. Further results may be obtained by β-differentiation, and new identities for matrix elements of $r^k \log(r)$ are given. The $n' = n$ matrix elements of r^k are studied for $k \geq -1$; closed product expressions are found for k-values near the sum and difference of the angular momenta, so that simple prescriptions can be given for the iterative calculation of n-dependent explicit forms. It is suggested that complex-variable theory be applied to a study of these results. (auth)

28075 MULTIPHOTON TRANSITIONS IN HYDROGEN ATOM. Thareja, R. K.; Haque, S. N. (Delhi Univ. (India). Dept. of Physics and Astrophysics). Phys. Lett., A; 48: No. 3, 231-232 (17 Jun 1974).

A correction to the Reiss amplitude is calculated. The numerical results obtained for the cross section for bound-bound transitions in hydrogen atom in the presence of intense electromagnetic field on applying Reiss approximation along with the correction factors are compared with the numerical results of Gontier and Trahin. (auth)

28076 THE STARK EFFECT ON THE hfs OF RELATIVISTIC H-LIKE ATOMS. Manakov, N. L.; Rapoport, L. P.; Zapryagaev, S. A. (Voronezhskij Gosudarstvennyj Univ. (USSR)). Phys. Lett., A; 48: No. 2, 145-146(3 Jun 1974).

The energy shift of relativistic H-like atoms is calculated to second order for the external field ϵ, and to the first order for the hyperfine-structure interaction. The relativistic correlations to scalar and tensor polarizability are presented. (auth)

28077 DETERMINATION OF HYPERFINE STRUCTURE OF HIGHLY EXCITED S STATES IN ALKALI ATOMS USING A CW DYE LASER. Tsekeris, P.; Gupta, R.; Happer, W. (Columbia Univ., New York (USA). Columbia Radiation Lab.); Belin, G.; Svanberg, S. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Fysik). Phys. Lett., A; 48: No. 2, 101-102 (3 Jun 1974).

The hyperfine structure of the $7\ ^2S_{\frac{1}{2}}$ state of ^{39}K and the $10\ ^2S_{\frac{1}{2}}$ and $11\ ^2S_{\frac{1}{2}}$ states of ^{133}Cs has been measured by rf spectroscopy experiments using a CW dye laser. (auth)

28078 THE CALCULATION OF DYNAMIC POLARIZABILITIES AND LONG-RANGE DISPERSION ENERGY COEFFICIENTS. Teixeira-Dias, J. J. C.; Varandas, A. J. C. (Coimbra Univ. (Portugal)). Chem. Phys. Lett.; 26: No. 2, 197-199(15 May 1974).

The variation-perturbation method previously used in the calculation of dynamic polarizabilities of the hydrogen atom and long-range dispersion energy coefficients between hydrogen atoms is applied, within the framework of uncoupled Hartree–Fock perturbation theory, to the dipole and quadrupole polarizabilities of the helium atom. It is shown that simple first order wavefunctions built up from Slater-type 2p and 3d orbitals with optimized frequency-dependent exponents yield quite accurate values for the dynamic polarizabilities of the helium atom and for the long-range dispersion energy coefficients. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

28079 $2S_{1/2} \rightarrow 1S_{1/2}$ + ONE–PHOTON DECAY OF MUONIC ATOMS AND PARITY–VIOLATING NEUTRAL–CURRENT INTERACTIONS. Feinberg, G. (Physics Department, Rockefeller University, New York, New York 10021 and Physics Department, Columbia University, New York, New York 10027); Chen, M.Y. Phys. Rev. D 10: No. 1, 190-203 (1 July 1974).

The decay $2S_{1/2} \rightarrow 1S_{1/2} + 1$ photon, in muonic atoms, is considered as a probe of parity–violating interactions between muons and nucleons. It is shown that a parity–violating interaction, arising from neutral currents, with a strength comparable to the Fermi interaction, would induce a small admixture of $2P_{1/2}$ state into the $2S_{1/2}$ state of muonic atoms, with a magnitude of approximately 10^{-7}. Such an admixture would allow the $2S_{1/2}$ to decay to $1S_{1/2} + 1$ photon by an E1 transition, as well as by the known M1 transition. Since the E1 matrix element is much larger than the M1 matrix element, the small state admixture will be enhanced in the decay matrix element. In particular, the circular polarization of the emitted photon, or the photon angular asymmetry relative to the muon polarization, would be of order 10^{-4} in nuclei near Z = 30, and so are perhaps measurable. The branching ratio of the $2S_{1/2} \rightarrow 1S_{1/2} + 1$–photon decay to other transitions from the $2S_{1/2}$ state is considered, and found to be around 10^{-3} in nuclei of interest. In an appendix, similar considerations are given for the $2S_{1/2} \rightarrow 1S_{1/2} + 1$–photon decay of electron hydrogenic ions, where it is found that the circular polarizations are much smaller, but the branching ratios can be substantially larger. (auth)

28080 MEASUREMENT OF THE INITIAL POPULATION AND DECAY RATE OF THE $(\mu^4He)^+_{1S}$ SYSTEM IN A HELIUM TARGET AT 50 ATM. Bertin, A.; Carboni, G.; Gorini, G.; Pitzurra, O.; Polacco, E.; Torelli, G.; Vitale, A.; Zavattini, E. (CERN, Geneva, Switzerland, and Instituto di Fisica dell'Università di Pisa and Instituto Nazionale di Fisica Nucleare, Sezione di Pisa, Italy). Phys. Rev. Lett. 33: No. 5, 253-256 (29 July 1974).

We have measured the fraction and lifetime of the $(\mu^4He)^+_{1S}$ systems formed by stopping negative muons in gaseous helium at 50 atm. An estimate of the external Auger effect, which contributes to depopulate the $(\mu He)^+_{1S}$ level, is given. First experimental evidence of the two–photon decay of such a level is presented. (auth)

28081 POSITRON ANNIHILATION IN ZINC ALLOYED WITH NITROGEN AND ZINC WITH IMPURITIES. Troev, T. D. (Inst. of Nuclear Research and Nuclear Energy, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 6, 779-782(1974).

In order to study positron annihilation, the momentum distribution of valence electrons was measured in specimens of 99.999% pure polycrystal zinc alloyed with nitrogen and zinc with 2 atomic % impurities of lead, cadmium, copper, and iron. An analysis of the correlation curves shows that with small angle deviations no apperance of a narrow component is observed. This means that the annihilation occurs without a bonded state–positronium Ps–being formed. (JFP)

28082 POSITRON ANNIHILATION IN TEFLON AND POLYETHYLENE. Kerr, D. P. (Univ. of Winnipeg, Manitoba). Can. J. Phys.; 52: No. 11, 935-939(1 Jun 1974).

Both the time spectra and the angular distributions of the annihilation gamma rays were measured for positrons annihilating in Teflon and polyethylene in an attempt to clarify which annihilation mechanisms account for the various lifetimes in these materials. Some authors have suggested that, in addition to the longest lifetime component, one of the shorter lived components also arises from the pickoff annihilation of orthopositronium. If this were the case, substantially more positronium would be formed than is indicated by the intensity of the longest lived component alone, and should be detectable through a measurement of the intensity of the low momentum portion of the

momentum distribution obtained from the angular correlation data. Four lifetimes are apparent in the time spectra although there is considerable uncertainty in resolving the two shortest components. The angular distribution data, in both cases, yielded a low momentum component whose intensity indicates that only the longest lifetime component arises from pickoff annihilation of orthopositronium. The three shorter lifetime components are discussed. (auth)

28083 ANNIHILATION IN POSITRON–HELIUM SCATTERING. Humberston, J. W. (University Coll., London). J. Phys., B (London); 7: No. 9, L286-L289(21 Jun 1974).

The positron-helium wave functions obtained previously (Humberston, J. Phys. B. Atom. Molec. Phys.; 6: L305-8 (1973)) are used to calculate the annihilation rate parameter Z_{eff} at several positron momenta. A mistake in the previously quoted value of Z_{eff} at zero energy for the helium model H5 is corrected, and the new result agrees well with a recent measurement. The angular distribution of the annihilation γ rays is also calculated, but the agreement with experiment is not as good for the model H5 as it is for the cruder model DB. An explanation of this phenomenon is suggested. (auth)

28084 POSITRON ANGULAR CORRELATION IN COPPER. Singru, R. M. (Indian Inst. of Tech., Kanpur). Pramana; 2: No. 6, 299-303(Jun 1974).

The two-photon pair momentum density and the angular correlation curves for positron annihilation radiation from copper were obtained by a band structure calculation, employing Hubbard's approximation scheme. A comparison of the calculated curve for the long slit geometry with the experimental results shows that the theory rather overestimates the contributions in the high momentum region. An angular correlation curve for a point slit geometry is also calculated. (auth)

28085 ANGULAR CORRELATION OF POSITRON ANNIHILATION IN KBr. Tseng, P. K.; Chang, P. K. L.; Jan, G. J. (National Taiwan Univ., Taipei, Taiwan, Republic of China, Dept. of Physics). Phys. Lett., A; 48: No. 3, 211-212(17 Jun 1974).

The angular distribution of two photons from the positron annihilation in the pure KBr crystal and in the colored KBr crystals is measured. The effects of F-centers on the positron annihilation in KBr crystals are analyzed. (auth)

Collision Phenomena

Refer also to abstracts 26989, 28041, 28068, 28083, and 28484.

28086 INTERSHELL AND INTERSUBSHELL EFFECTS IN PHOTOIONIZATION OF ATOMS. Amus'ya, M. Ya.; Ivanov, V. K.; Cherepkov, N. A.; Chernysheva, L. V. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1537-1549(May 1974). (In Russian).

Partial photoionization cross sections for weak transitions in a number of atoms are obtained by taking into account inter-shell interaction. It is shown that the effect of neighboring many-electron shells or subshells may lead to a qualitatively new behavior of the photoabsorption cross section. Three cases are considered: the effect of an outer subshell on photoionization of an inner shell, e.g. photoionization of s^2-subshells of noble gas atoms; effect of an inner shell on the outer one, e.g. photoionization of Ca or Zn $4s^2$-subshells; effect of an inner shell near its ionization threshold on outer shells, e. g. the single ionization cross section for Kr or Xe near the d^{10}-subshell thresholds. In all cases the agreement with the experiments is improved. (auth)

28087 MIXING OF DEGENERATE STATES OF EXCITED HYDROGEN ATOM IN DISTANT COLLISIONS WITH CHARGED PARTICLES. Ostrovskii, V. N.; Solov'ev, E. A. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1590-1598(May 1974). (In Russian).

The inelastic scattering differential cross sections for collision between a charged particle and excited hydrogen atom involving transitions between degenerate atomic states with identical principal quantum numbers n are calculated. The Schroedinger equation is solved in the basis of n^2 degenerate atomic states. The dipole approximation is employed for the interaction with the incident particle. The problem is solved in the quasiclassical approximation with respect to the colliding particles motion, but in a somewhat modified form. In this case dynamic wave functions of the quasimolecule arise which are similar to those obtained previously in the nonstationary problem. They yield a mutually consistent description of the atomic state and of the motion of the colliding particles. Since the effective interaction significantly depends on the dynamic term, scattering over a certain angle corresponds to several different quasiclassical trajectories and thus leads to interference oscillations in the cross sections. Mixing of 2s and 2p states is considered in detail. (auth)

28088 OSCILLATIONS IN SYMMETRICAL CHARGE TRANSFER CROSS SECTIONS. Dewangan, D. P. (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys.; 48: No. 3, 269-283 (Mar 1974).

The total cross sections for Li^+-Li, Na^+-Na and K^+-K charge transfer are calculated by the impact-parameter method using Clementi's analytic Hartree-Fock wave functions. Results show oscillations in all the cases. The calculated cross sections are compared with the experimental results and are discussed in the light of previous theoretical investigations. (auth)

28089 APPROXIMATE ANALYTICAL EXPRESSION FOR THE DIFFERENTIAL DISPERSION CROSS-SECTION OF LOW-ENERGY GAMMA RADIATION. Pshenichnyi, G. A.; Meier, V. A.; Bakhtiarov, A. V. Uch. Zap. Leningrad. Gos. Univ., Ser. Fiz. Geol. Nauk; No. 23, 193-208(1973). (In Russian).

The subject expression was derived relative to coherent and noncoherent dispersion on bound electrons of an atom. The special features of the dependence of the differential cross section values on the gamma energy, the angle of dispersion, and the atomic number of the element are discussed. The results of the analytical calculations are compared with calculations made in strict accordance with quantum mechanics theory. Analytical calculations for the differential cross sections for tin atoms with gammas of from 100 eV to 10 MeV with consideration of anomalous dispersions at K, L, and M levels of the atom are given. (tr-auth)

28090 SURFACE AND VACUUM PHYSICS INDEX. Volume 9, No. 6, 1974. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 55p.

28091 MEASUREMENT OF ACTIVATION CROSS-SECTION OF KrI LINES BY ELECTRON COLLISION. Rostovikova, G. S.; Samoilov, V. P.; Smirnov, Yu. M. Tr. Mosk. Energ. Inst., Fiz.; No. 144, 99-102(1972). (In Russian).

The activation cross sections for the KrI lines in the ultraviolet (3180-5870 Å), using the lines of the visible spectrum for calibration. The measurements were made in equipment at $2-5 \times 10^{-4}$ Torr. The results show a sharp maximum close to the energy threshold, followed by a drop. A second maximum at 5339.13 Å may be related to cascade processes. The results are tabulated and are also presented graphically. (TTT)

28092 EXPERIMENTAL MEASUREMENTS OF ELECTRON TRANSFER CROSS SECTIONS FOR CARBON, NITROGEN, AND FLUORINE IONS IN ARGON, KRYPTON, AND XENON GASES AT HIGH ENERGIES. Chino, T. Manhattan, KS; Kansas State Univ. (1974). 265p. University Microfilms Order No. 74-17,506.

Thesis (Ph. D.).

An experimental study of the electron transfer cross sections of atomic particles in collisions with gaseous atoms was made. The experiments were carried out in the energy range of 4 to 54 MeV with carbon, nitrogen, and fluorine ions as projectiles. The targets used in the experiments were nitrogen molecules, and argon, krypton, and xenon atoms. A brief experimental as well as a theoretical review of the work on the electron transfer process in atomic collisions was given. The equipment used in the experiments, experimental setup, and experimental procedure are described in detail. The method of data analysis and an estimate of experimental uncertainties for this work are given. The experimental results are presented. This includes the single and multiple electron capture and loss cross sections; a discussion of the results as a function of ion velocity, of charge state of projectile, and of atomic number of projectile is given; and finally, the experimental results are compared with appropriate theoretical calculations. (Diss. Abstr. Int., B)

28093 EXCITATION AND IONIZATION OF HELIUM BY ELECTRON IMPACT USING DISTORTED-WAVE THEORY. Baluja, K. L. Tallahassee, FL; Florida State Univ. (1973). 221p. University Microfilms Order No. 74-17,983.

Thesis (Ph. D.).

The distorted-wave theory was applied to calculate the differential and integral cross sections of the excitation of N = 2 optically forbidden states of helium, and the triple differential cross sections for the ionization of helium by electron impact. An expression for triple differential cross section of ionization of helium by electron impact is derived. For the case of excitation of helium, differential cross sections are given for incident-electron energies between 26.5 eV and 225 eV. The distorted-wave results are compared with experimental work and theoretical results of

various plane-wave approximations. The distorted-wave calculations showed an improvement over these plane-wave approximations. For the case of ionization of helium by electron impact, the energy of the incident electron is always 256.5 eV. The theoretical results of triple differential cross sections using distorted-wave approximation are compared with the experimental results and the plane-wave calculations. The distorted-wave results showed marked improvement over the plane-wave calculations in fitting the experimental angular distributions of the ejected electrons resulting from the ionization of helium by electron impact for all kinematic parameters. (Diss. Abstr. Int., B)

28094 LOW-ENERGY SCATTERING OF He^{++} BY NEON, ARGON, AND KRYPTON. Austin, T. M. Gainesville, FL; Univ. of Florida (1973). 148p. University Microfilms Order No. 74-19,121.

Thesis (Ph. D.).

Experimental studies of the scattering of He^{2+} ions by Ne, Ar, and Kr atoms were carried out in the laboratory energy range, 8 to 60 eV. For each of the collision pairs, relative differential cross sections were measured for elastic scattering, and for the formation of He^+ by single charge transfer with the rare gas target atoms, $He^{2+} + R = He^+ + R^+$. Kinematical studies of the inelastically scattered He^+ were performed to obtain information concerning the electronic states of the He^+ and R^+ charge transfer products. From the kinematical studies, it was found that the single charge transfer for the $He^{2+}-Ne$ collision is exothermic by 5.9 eV, and that only a single inelastic channel is involved in the transfer. After the transfer collision, He^+ is in its ground electronic state, whereas the Ne^+ is internally excited to 26.9 eV above its ground electronic state. The charge transfer collisions $He^{2+}-Ar$, Kr were found to be many state processes. The exothermicity in the case of $He^{2+}-Ar$ spans the range 6.6 to 13.8 eV. For $He^{2+}-Kr$, the exothermicity ranged from 7.7 eV to 14.8 eV. For both cases, He^+ was in its ground electronic state after the charge transfer. However, excited states of Ar^+ extend into the Ar^+ continuum; i.e., formation of Ar^{2+}, as well as excited Ar^+ in a number of excited states, is possible. Kr^+ was excited above the Kr^+ ionization limit; it lies among the low lying Kr^{2+} excited states. An approximate form of the optical model, in conjunction with the elastic scattering data, was used to estimate the ground state intermolecular potentials for the $He^{2+}-Ne$, $He^{2+}-Ar$, and $He^{2+}-Kr$ systems. These studies indicated that the shoulders observed in the differential elastic scattering patterns were attributable to scattering from an attractive potential well, in the presence of concurrent inelastic scattering. Using a parameterized Morse potential in the optical model calculations, ground state molecular potential well depths for $(HeNe)^{2+}$, $(HeAr)^{2+}$, and $(HeKr)^{2+}$ were found to be, respectively, 1.0 eV, 2.1 eV, and 2.6 eV. Experimental differential cross sections are presented for the systems: H^+-Ar, $He^{2+}-He$, F^+-Ar, O^+-Ar, H^+-O_2, and $He^{2+}-CO_2$. (Diss. Abstr. Int., B)

28095 OPTICAL STUDIES OF THE PRODUCTS OF CHARGE EXCHANGE BETWEEN He^+ AND CO. Coplan, M.A.; Ogilvie, K.W. (Institute for Fluid Dynamics and Applied Mathematics, University of Maryland, College Park, Maryland 20742). J. Chem. Phys. 61: No. 5, 2010-2014 (1 Sept 1974).

The optical emission from the A–X and B–X transitions of CO^+ produced by charge exchange collisions between He^+ and CO have been examined over the incident ion energy range 500 to 1500 eV. Absolute excitation cross sections for the transitions were measured from 200 to 1500 eV and compared with measurements of the total charge exchange cross section. To account for the difference between the two sets of measurements, amounting to a factor of 30 at low ion energies and a factor of 4 at higher energies, alternate reactions are proposed. (auth)

28096 HIGH TEMPERATURE NEGATIVE IONS. ELECTRON IMPACT STUDY OF TETRATOMIC PHOSPHORUS VAPOR. Bennett, S.L.; Margrave, J.L.; Franklin, J.L. (Department of Chemistry, Rice University, Houston, Texas 77001). J. Chem. Phys. 61: No. 5, 1647-1651 (1 Sept 1974).

Appearance potentials and ion translational energies have been measured for the negative ions P, P_2^-, and P_3^- formed by dissociative resonance capture of P_4. The following thermochemical values (all in kcal $mole^{-1}$) have been obtained: $\Delta H^\circ_{f,298}(P_2^-) = 37.2 \pm 4.8$; $E.A.(P_2) = 5.5 \pm 5.3$; and $\Delta H^\circ_{f,298}(P_3^-) = 38.2 \pm 4.5$. The P^- ion appears to be formed in its first excited state on low-energy electron impact of P_4, and the derived heat of formation of P_3, $\Delta H^\circ_{f,298}(P_3,g) = 59.4 \pm 4.0$, is proposed. The measurement of the increase in translational energy across resonance gave α (where α serves as the fraction of the oscillators in the transition complex which are effective for the distribution of the excess energy) = 0.43 for the three processes studied. (auth)

28097 MERGING BEAMS STUDY OF THE REACTION H_2^+ (D,H) HD^+. Wendell, K.L.; Rol, P.K. (Research Institute for Engineering Sciences and Department of Chemical Engineering and Material Sciences, Wayne State University, Detroit, Michigan 48202). J. Chem. Phys. 61: No. 5, 2059-2061 (1 Sept 1974).

The merging beams technique was used to study the reaction H_2^+ (D,H) HD^+ in the energy range of 0.05–12 eV. The cross sections for the reaction have been measured in the range 0.05–5 eV, and at 2 eV there is good agreement with trajectory surface hopping calculations. The diatomic product is scattered forward with respect to the direction of the neutral beam in the c.m. coordinate system over the entire energy range. The relative kinetic energy of the products is nearly equal to the relative kinetic energy of the reactants. (auth)

28098 CROSS SECTIONS FOR DIRECT AND CHARGE–EXCHANGE EXCITATION IN SOME ALKALI ION–ATOM COLLISIONS. Aquilanti, V.; Bellu, G.P. (Dipartimento di Chimica dell'Università, 06100 Perugia, Italy). J. Chem. Phys. 61: No. 5, 1618-1620 (1 Sept 1974).

Absolute total cross sections for inelastic processes in (Li^+, Na), (Li^+, K), (Na^+, K), and (K^+, Na) collisions have been measured at ion energies lower than 1.5 keV. Both direct and charge–transfer excitation have been observed. The results are interpreted in terms of the electronic structure of asymmetric alkali dimer ions. (auth)

28099 THE REPULSIVE $^1\Sigma_g^+$ He_2 POTENTIAL OBTAINED FROM TOTAL CROSS SECTIONS. Foreman, P.B.; Rol, P.K. (Research Institute for Engineering Sciences and Department of Chemical Engineering and Material Sciences, Wayne State University, Detroit, Michigan 48202); Coffin, K.P. J. Chem. Phys. 61: No. 5, 1658-1665 (1 Sept 1974).

An improved apparatus for obtaining short–range intermolecular potentials is described. The measured ground state He–He potential in the range $0.49 \leqslant r \leqslant 1.56$ Å is $V(r) = (215.3 \pm 9.4) \exp[-(3.950 \pm 0.044)r]$ eV. This agrees extremely well with the results of molecular orbital theory, whereas earlier experiments were 25% lower, and is confirmed by a recent independent measurement in the range 0.9–1.5 Å. A comparison is also made with statistical model calculations. (auth)

28100 NEGATIVE ION CONTAMINATION OF ELECTRON IMPACT SPECTRA. Lassettre, E.N.; Huo, W.M. (Center for Special Studies and the Department of Chemistry, Mellon Institute of Science, Carnegie–Mellon University, Pittsburgh, Pennsylvania 15213). J. Chem. Phys. 61: No. 5, 1703-1707 (1 Sept 1974).

Since two particles with the same charges and the same kinetic energies are transmitted equally by electrostatic velocity analyzers regardless of mass, it follows that negative ions produced on electron impact with a gas can interfere with the electron impact spectrum of the gas. Possible contribution of negative ions to the electron impact spectrum of water is studied by theoretical means. It is concluded that H^- ions can contribute peaks to the spectrum in the apparent energy loss range 4–6 eV if the spectrum is produced by electrons with kinetic energy in the range 5–7 eV. With incident kinetic energies of 15 eV or higher negative ion contamination is not important. In general, negative ion interference can be important, especially for hydrogen containing compounds, when (a) the kinetic energy of incidence is very low and (b) when the electron spectrometer employed contains only electrostatic lenses and analyzers. These considerations suggest that negative ion spectra might be studied as a means of detecting excited quantum states of radical fragments especially for hydrogen containing substances which give H^- on collision with electrons. (auth)

28101 ELECTRON ENERGY DEPENDENCE OF THE KINETIC ENERGY AND ANGULAR DISTRIBUTIONS OF O^+ FROM DISSOCIATIVE IONIZATION OF O_2. Van Brunt, R.J. (University of Virginia, Charlottesville, Virginia 22901); Lawrence, G.M.; Kieffer, L.J.; Slater, J.M. J. Chem. Phys. 61: No. 5, 2032-2037 (1 Sept 1974).

The electron energy dependence of the kinetic energy and angular distributions of O^+ have been measured for the process of dissociative ionization of O_2. The kinetic energy distributions for energies above 0.5 eV are compared with other dissociative ionization measurements as well as results of dissociative photoionization and dissociative excitation by electrons leading to production of Rydberg excited neutral fragments. Angular distributions are interpreted in terms of symmetries of possible molecular ion states contributing to dissociation, and the results near threshold are compared with recent measurements of O from dissociative ion pair formation in O_2. Information about the states of excitation of the dissociation fragments as a function of ion energy is obtained from appearance potential measurements. The results indicate that predissociation may be important and that dissociative ionization of O_2 is in general a complicated process involving many O_2^+ states. (auth)

28102 RESTRICTIONS ON THE POTENTIAL AND CROSS SECTION FOR COLLISIONS BETWEEN RIGID ROTORS. Biolsi,

L. (Department of Chemistry, University of Missouri—Rolla, Rolla, Missouri 65401). J. Chem. Phys. 61: No. 5, 2004-2009 (1 Sept 1974).

A restricted distorted—wave treatment of the total cross section when two rigid diatomic molecules with orbital and nuclear spin angular momenta collide is examined. There are certain restrictions on the intermolecular potential and on the possible combinations of the various quantum numbers. These restictions are examined for the lowest order nonspherical elastic and the lowest order inelastic contributions to the total cross section. The effects of degeneracy averaging and of collisions between indistinguishable molecules are also briefly examined. (auth)

28103 MEASUREMENTS OF ION—MOLECULE REACTIONS OF He^+, H^+, AND HeH^+ WITH H_2 AND D_2. Johnsen, R.; Biondi, M.A. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). J. Chem. Phys. 61: No. 5, 2112-2115 (1 Sept 1974).

A drift tube—mass spectrometer apparatus has been used to determine the rate coefficient, energy dependence, and product ions of the reaction $He^+ + H_2$. The total rate coefficient at 300 K is $(1.1\pm0.1) \times10^{-13}$ cm^3/sec. The reaction proceeds principally (80%) by dissociative charge transfer to produce H^+, with the small remainder going by charge transfer to produce H_2^+ and by atom rearrrangement to produce HeH^+. The rate coefficient increases slowly with increasing ion mean energy, reaching a value of 2.8×10^{-13} cm^3/sec at 0.18 eV. The corresponding reaction with deuterium, $He^+ + D_2$, exhibits a value $(5\pm1) \times10^{-14}$ cm^3/sec at 300 K. The reaction rates for conversion of H^+ and HeH^+ to H_3^+ on collisions with H_2 molecules are found to agree well with results of previous investigations. (auth)

28104 DECONVOLUTION METHODS IN ELASTIC TOTAL CROSS SECTION MEASUREMENTS. Sheen, S.H.; Skofronick, J.G. (Department of Physics, Florida State University, Tallahassee, Florida 32306). J. Chem. Phys. 61: No. 4, 1430-1434 (15 Aug 1974).

Deconvolution methods and their applicability to removal of distortion in elastic total cross section measurements will be discussed. The usefulness and the "end effect" problems of the iterative method of Van Cittert will be presented, along with an analytic method to remove the end effect problem. Application to $^4He+^4He$ total cross section measurements will be made. (auth)

28105 MICROSCOPIC REVERSIBILITY AND COMPLEX—VALUED TRAJECTORIES IN A SEMICLASSICAL THEORY OF MOLECULAR COLLISIONS. Lin, Y.; George, T.F. (Department of Chemistry, The University of Rochester, Rochester, New York 14627). J. Chem. Phys. 61: No. 4, 1510-1516 (15 Aug 1974).

The role of microscopic reversibility and time reversal in a semiclassical theory of molecular collisions is discussed. The boundary conditions for time—reversed classical trajectories are written in terms of those for forward trajectories in a manner consistent with microscopic reversibility. Special care must be taken in calculating time—reversed complex—valued trajectories when branch points exist in the complex time plane. Such points can arise from an explicit branch point structure of the potential energy function, such as in a semiclassical treatment of electronic transitions, and/or from the branch point structure of the numerically computed equations of motion. If a forward trajectory crosses a branch cut in the upper (lower) half time plane, the time—reversed trajectory must cross the corresponding branch cut in the lower (upper) half time—plane. (auth)

28106 MOLECULAR CHARGE TRANSFER. II. EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE ROLE OF INCIDENT—ION VIBRATIONAL STATES IN $O^+{}_2-O_2$ AND NO^+-NO COLLISIONS. Moran, T.F.; Flannery, M.R.; Cosby, P.C. (Georgia Institute of Technology, Atlanta, Georgia 30332). J. Chem. Phys. 61: No. 4, 1261-1273 (15 Aug 1974).

Charge—transfer cross sections are measured for the $O^+{}_2-O_2$ and NO^+-NO systems and are compared with those calculated from a theoretical multistate impact parameter model for which the resulting coupled first—order differential equations are solved numerically. Convergence in the theoretical total cross sections is achieved by the systematic introduction of as many as 54 product states to the wavefunction expansion for the total system. At high kinetic energies (~2 keV) the computed cross sections are controlled predominantly by the magnitude of the vibrational overlaps between the reactant and product states, and multiquantum transitions do occur with high efficiency. At lower energies, the energy defects and vibrational overlaps of the various product channels tend to control the reaction pathways. Total charge—transfer cross sections measured as a function of reactant ion vibrational and translational energy are found to be in general accord with the computed multistate cross sections. In the low velocity limit, an approximation which assumes that all product channels with small energy defect are degenerate with the incident channel provides a reasonable description of the charge—transfer process at ion kinetic energies less than 200 eV. (auth)

28107 ELECTRONIC—ENERGY EXCHANGE CROSS SECTIONS FOR AR^* (^3P) AND N_2 ($X^1\Sigma_g^+$). Wimicur, D.H.; Fraites, J.L. (Chemistry Department and the Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). J. Chem. Phys. 61: No. 4, 1548-1553 (15 Aug 1974).

Differential cross sections for Ar^* (^3P) scattered by $N_2(X^1\Sigma_g^+)$, obtained at 0.051 eV using crossed molecular beams, are reported from 4° to 174° c.m. A rainbow maximum is observed at 6.3° c.m. The small—angle elastic scattering is analyzed to obtain parameters for a double—Lennard—Jones potential. At large angles the cross sections are depleted by exchange scattering. The exchange probabilities are obtained by subtracting the experimental cross sections from elastic scattering cross sections calculated from the double—Lennard—Jones parameters. The resulting total exchange cross section and threshold energy are σ_{ex} = 11.8+3.5 Å, E_0=0.0081+0.001 eV. Comparison with cross sections deduced from published rate constants indicates that σ_{ex} increases with initial relative kinetic energy from threshold to 0.051 eV. (auth)

28108 DIRECT OBSERVATION OF EXCHANGE SCATTERING BY SPIN FLIP OF POLARIZED ELECTRONS IN EXCITATION OF MERCURY. Hanne, G.F.; Kessler, J. (Physikalisches Institut der Universität Münster, Münster, Germany). Phys. Rev. Lett. 33: No. 6, 341-343 (5 Aug 1974).

Exchange scattering has been directly observed in the excitation of the 6^1P state of mercury by measuring the spin flip of polarized electrons. Between threshold and 8 eV exchange scattering dominates, resulting in a reversal of the direction of polarization of the scattered electrons. Above 8 eV the influence of exchange decreases rapidly for scattering in the forward direction. (auth)

28109 THEORY OF LOW-ENERGY ELECTRON SCATTERING BY POLYATOMIC MOLECULES. I. Onda, K. (Tokyo Univ.). J. Phys. Soc. Jap.; 36: No. 3, 826-838(Mar 1974).

The variational method is developed to attack the scattering of low energy electrons by polyatomic molecules. The form chosen for a trial function is $F(r) = F^{short}(r) + F^{long}(r)$, where $F^{short}(r)$ is the linear combination of quadratically integrable functions with their centers at constituent atoms of the molecule, r the position vector of the scattered electron, and $F^{long}(r)$ chosen so as to include distortion of the scattered wave caused by long range forces is smoothly connected to the free particle wave function. The applicability of this theory is tested by a numerical example, in which the calculation is made for the elastic scattering of electrons by the static field of H_2 in the two-center coordinate system and the results are compared with the Hara's (J. Phys. Soc. Japan 27 (1969)1009). (auth)

28110 SEARCH FOR LOW-LYING RESONANCES IN ELECTRON SCATTERING BY ATOMIC HYDROGEN. Spence, D.; Inokuti, M. (Argonne National Lab., IL). J. Quant. Spectrosc. Radiative Transfer; 14: No. 9, 953-957(Sep 1974).

Measurements of the transmission of an energy-selected electron beam through atomic hydrogen fail to indicate any resonance below 9.5 eV electron energy. The negative result contradicts recent suggestions by Rudkjobing (JQSRT; 13:1479 (1973)) and by Van Rensbergen (JQSRT; 12:1105 (1972)) that some diffuse interstellar absorption bands might be attributable to preionizing transitions in the hydrogen negative ion. A bulk of reliable theoretical data, however, justifies the present finding. (auth)

28111 SURFACE AND VACUUM PHYSICS INDEX. Volume 9, No. 5, 1974. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 51p.

28112 INVERTED DOPPLER SHIFT ATTENUATION METHOD: A NEW METHOD FOR THE INVESTIGATION OF ATOMIC AND MOLECULAR CHARGE DISTRIBUTIONS. Hauser, U.; Neuwirth, W.; Pietsch, W.; Richter, K. (Univ., Cologne). Radiochem. Radioanal. Lett.; 18: No. 5, 301-309(21 Sep 1974).

A new method for the determination of the specific energy loss of charged particles in matter is described. It is based on the Doppler shift of gamma quanta emitted by moving excited nuclei. The specific energy loss is very sensitive to the actual charge distribution of the target atoms which is demonstrated by several examples. Therefore, one of the possible applications of this method is the investigation of atomic and molecular charge distributions which is exemplified in the last part of this paper. (auth)

28113 OBSERVATION OF A PROJECTILE CHARGE DEPENDENCE FOR THE NEON K-AUGER ELECTRON SPECTRUM. Moore, C. F.; Mackey, J. J.; Smith, L. E.; Bolger, J.; Johnson, B. M.; Matthews, D. L. (Univ. of Texas, Austin). J. Phys., B (London); 7: No. 9, L302-L304(21 Jun 1974).

Oxygen (plus six) and (plus eight) at 30 MeV incident energy were used to induce Auger electron spectra of Ne. The high

instrumental resolution (0.02% FWHM) spectra show specifically that the charge state of the incident oxygen ion considerably affects the distribution of the K-Auger electron yield among the charge states of muliply ionized neon. (auth)

28114 MULTICHANNEL VARIATIONAL CALCULATION FOR THE LOW ENERGY E–He SCATTERING. Wichmann, E.; Heiss, P. (Univ., Cologne). J. Phys., B (London); 7: No. 9, 1042-1051(21 Jun 1974).

Starting from a five state (1S-2S-2P) close coupling approximation, a variational calculation was performed for the low energy e-He collision. Cross sections for elastic scattering from the He ground state and the first excited state and for the transition between these states were derived. Comparison with experiment shows good agreement between calculated and experimental results. (auth)

28115 APPLICATION OF THE BREIT–PAULI APPROXIMATION TO THE STUDY OF RELATIVISTIC EFFECTS IN ELECTRON-ATOM SCATTERING. Jones, M. (University Coll., London). J. Phys., B (London); 7: No. 9, L284-L285(21 Jun 1974).

A preliminary report is given of a study in which relativistic effects on total collision strengths are considered within a formulation which is based upon the Breit-Pauli approximation. (auth)

28116 SCATTERING CROSS SECTIONS FOR 40 eV TO 1 KeV ELECTRONS COLLIDING ELASTICALLY WITH NITROGEN AND OXYGEN. Wedde, T. (Norwegian Defence Research Establishment, Kjeller); Strand, T. G. J. Phys., B (London); 7: No. 9, 1091-1100(21 Jun 1974).

A phase-amplitude method was used in deriving differential and total elastic scattering cross sections for electron collisions in atomic and diatomic molecular nitrogen and oxygen. The energy range considered was from 1 keV to below 50 eV. Available theoretical and experimental cross sections for both atoms and molecules were compared with the present calculations. (auth)

28117 ANGULAR DISTRIBUTIONS OF NEUTRAL PARTICLES PRODUCED BY CHARGE EXCHANGE IN HIGH ENERGY H_3^+, D_3^+, AND D_2H^+ ON H_2O MOLECULE COLLISIONS. Bordena ve-Montesquieu, D.; Blanc, D.; Dagnac, R. (Univ., Toulouse). J. Phys., B (London); 7: No. 9, L290-L293(21 Jun 1974).

Neutral particle angular distributions were determined in charge exchange collisions of atomic (H^+, He^+, Ne^+, Ar^+), diatomic (H_2^+, N_2^+, O_2^+, NO^+) and triatomic (H_2O^+, H_3^+, D_3^+, HD_2^+) ions on water molecules, in the energy range 5 to 50 keV. A minimum is observed at zero angle for collisions involving the triatomic ions H_3^+, D_3^+, and HD_2^+; this result is compared to predictions derived from Fan's classical theory. (auth)

28118 MONTE CARLO CALCULATIONS OF REACTION RATES AND ENERGY DISTRIBUTIONS AMONG REACTION PRODUCTS, $F + D_2 \rightarrow DF + D$. Wilkins, R. L. (Aerospace Corp., El Segundo, CA). Mol. Phys.; 28: No. 1, 21-31(Jul 1974).

A three-dimensional classical trajectory analysis is used to determine the reaction dynamics of the reaction $F + D_2(v, J) \rightarrow DF(v', J') + D$ on an assumed London-Eyring-Polanyi-Sato (LEPS) potential energy surface. Monte Carlo procedures are used to start each collision trajectory. An analysis is presented of the dependences of the total reaction cross sections σ_r and specific reaction cross sections $\sigma(v, J, v', E_R)$ on the relative translational energy and initial vibrational and rotational energy of the reagent molecule $D_2(v, J)$. Data are presented of the temperature dependences of the vibrational, rotational and translational energy distributions of the reaction products and the rate constants for formation of DF in specific vibrational and rotational states. The probability that direct reaction between atomic fluorine and molecular deuterium will lead to formation of DF in the $v' = 0$ state was found to be zero. The ratio $k(v' = 4)/k(v' = 3)$ appears to be independent of temperature and has a value of 0.65, which is in excellent agreement with recent infrared chemiluminescence experimental data. The ratio $k(v' = 2)/k(v' = 3)$ has a slight temperature dependence and, at room temperature, has a value of 0.28. The ratio $k(v' = 1)/k(v' = 3)$ was assumed independent of temperature and was assigned a value of 0.08. The results are compared with available experimental data and with previous theoretical studies. (auth)

28119 ATOMIC SCATTERING FROM HEAVY P-STATE ATOMS. Role of Depolarization. Fluendy, M. A. D.; Kerr, I. H.; Lawley, K. P. (Univ. of Edinburgh). Mol. Phys.; 28: No. 1, 69-80(Jul 1974).

The anisotropy of the potential between two atoms, one at least of which has $J > 1/2$, can cause partial re-alignment of the electronic angular momentum vector (i.e. M_J transitions) during collision. Within the framework of the semi-classical approximation, a single parameter akin to the Massey parameter is found to determine whether a given system will exhibit strong or weak coupling of the electronic to the relative atomic angular momentum. The consequence of these two coupling schemes for the position of the rainbow, the quenching of glory undulations and the magnitude of the total cross section are discussed. Particular reference is made to the metastable $^3P_2$ state of Hg and the inert gases where the fine structure splitting is much larger than the relevant part of the interatomic potential. In the case of Kr^* and Xe^* the rainbow and glory features are strongly dependent on the initial M_J state of the atom and the glory structure should be suppressed. In contrast, scattering from systems such as Hg^*/Na or Hg^*/Hg should take place under weak coupling conditions. (auth)

28120 PARTIALLY SUMMED HOLE-PARTICLE VERTEX AND ITS USE IN ELECTRON-ATOM INELASTIC SCATTERING. Yaris, R. (Washington Univ., St. Louis). J. Phys., B (London); 7: No. 9, 1066-1075(21 Jun 1974).

By using functional differentiation techniques it is shown how to obtain an expression for the hole-particle vertex function which has been partially summed. This expression is approximated in low order and inserted into the Bethe-Salpeter equation. An amplitude equation is thus obtained previously derived by another method by Csanak et al (J. Phys. B. Atom. Molec. Phys.; 6: 2040-54 (1973)) which has been suggested as a good "second-order" theory for inelastic electron-atom scattering. The perturbational analysis of the approximate response functions is discussed. (auth)

28121 ELASTIC SCATTERING OF ELECTRONS FROM ARGON. Lewis, B. R.; Furness, J. B.; Teubner, P. J. O.; Weigold, E. (Flinders Univ. of South Australia, Bedford Park). J. Phys., B (London); 7: No. 9, 1083-1090(21 Jun 1974).

Measurements are reported of angular distributions for electrons elastically scattered from argon in the energy range from 15 to 200 eV. A modulated crossed beam technique was employed and an angular resolution of about 3° realized in the range 20 to 140°. The results agree well with those of previous workers at the higher energies but it is observed that the dynamic range of the present results is far greater at the intermediate and lower energies. Angular distributions were calculated using a semiphenomenological optical model and good agreement found with the experimental data down to 30 eV. The recent relativistic calculations of Walker (Adv. Phys.; 20: 257-323 (1971)) are in good agreement with the data over the whole energy range. The measured relative dependence with energy of the differential cross section at 30° is compared with theory and a previous experiment. (auth)

28122 ANISOTROPIC EMISSION OF NONCHARACTERISTIC X RAYS FROM LOW–ENERGY I–Au COLLISIONS. Kraft, G. (Gesellschaft für Schwerionenforschung, Darmstadt, Germany); Mokler, P.H.; Stein, H.J. Phys. Rev. Lett. 33: No. 8, 476-479 (19 Aug 1974).

The x–ray emission for 6– to 60–MeV iodine bombardment on thin Au targets was measured. Spectra, cross sections, and angular dependence of x–ray emission are reported. Special emphasis is placed on the noncharacteristic radiation formerly interpreted as M radiation of a quasiatom with an effective atomic number of 132. The emission of this radiation is found to be nonisotropic, strongly supporting the model of induced emission in the collision molecule. (auth)

28123 EVIDENCE FOR QUASIMOLECULAR K X–RAY EMISSION IN HEAVY–ION COLLISIONS FROM THE OBSERVATION OF THE X–RAY DIRECTIONAL ANISOTROPY. Greenberg, J.S.; Davis, C.K.; Vincent, P. (Wright Nuclear Structure Laboratory, Yale University, New Haven, Connectucut 06520). Phys. Rev. Lett. 33: No. 8, 473-476 (19 Aug 1974).

We have observed an anisotropic angular distribution for the high–energy continuum x rays emitted in high–energy collisions of Ni ions with Ni atoms. The variation of the anisotropy with photon energy is uniquely characteristic of induced radiative transitions in quasimolecules, and hence provides strong evidence for the quasimolecular origin of these radiations. (auth)

28124 THEORY OF INDUCED MOLECULAR–ORBITAL K X RAYS IN HEAVY–ION COLLISIONS. Müller, B.; Greiner, W. (Wright Nuclear Structure Lab, Yale University, New Haven, Connecticut 06520). Phys. Rev. Lett. 33: No. 8, 469-473 (19 Aug 1974).

The mechanisms of spontaneous and induced emission of radiation are derived from the Dirac equation in a rotating coordinate system. The molecular–orbital x–ray spectra exhibit a strong asymmetry with respect to the beam axis. The asymmetry peaks for the high–energy transitions, which can be used for spectroscopy of two–center orbitals. (auth)

28125 (e, 2e) REACTION AS A PROBE FOR DETAILS OF THE HELIUM WAVE FUNCTION. McCarthy, I.E.; Ugbabe, A.;

Weigold, E.; Teubner, P.J.O. (School of Physical Sciences, The Flinders University of South Australia, Bedford Park, South Australia, 5042, Australia). Phys. Rev. Lett. 33: No. 8, 459-462 (19 Aug 1974).

The differential–cross–section ratios have been measured for excitation of the n=2 and n=1 He^+ states in the electron–impact ionization of helium using the coplanar symmetric geometry. This reaction is a crucial test of the reaction model and of the helium wave function. The experiment is sensitive enough to rule out the Hartree–Fock function. Excellent agreement is obtained by using a configuration–interaction wave function. (auth)

28126 THREE-BODY ION-NEUTRAL ASSOCIATION. Bates, D. R.; McKibbin, C. S. (Queen's Univ., Belfast). Proc. Roy. Soc. (London), Ser. A.; 339: No. 1616, 13-28(23 Jul 1974).

Consideration is given to the calculation of the rate coefficient of processes of the type $A^+ + B + C \rightarrow AB^+ + C$. Classical mechanics is used. The impulse approximation is adopted and hard-sphere interactions are taken to describe $C - A^+$ and $C - B$ collisions. Formulae are derived for the rate coefficients of binary collisions giving specified changes in the internal energy of the associating pair (without reference to their orbital angular momentum) and also of binary collisions giving specified changes in both the internal energy and in the square of the orbital angular momentum. By using quasi-equilibrium statistical theory, the rate coefficient for three-body ion-neutral association is expressed in terms of either set of binary rate coefficients. Computations are carried out only on $Hg^+ + Hg + He \rightarrow Hg_2^+ + He$. As expected, the predicted rate coefficient is too high if specific account is not taken of the orbital angular momentum. If such account is taken excellent agreement is obtained with a measurement at 370 K made by Biondi (1953 and 1972). The rate coefficient falls off slowly as the temperature is increased. (auth)

28127 CALCULATIONS OF VIBRATIONAL ENERGY TRANSFER USING SEMI-CLASSICAL S MATRIX THEORY. Cohen, S. C. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center); Alexander, M. H. (Maryland Univ., College Park (USA). Dept. of Chemistry). Chem. Phys. Lett.; 26: No. 2, 256-260(15 May 1974).

An extension of Miller's semi-classical S matrix theory is utilized to calculate resonant and non-resonant vibrational energy transfer probabilities. The collisions under study are collinear D_2-D_2 interactions at energies below and above the classical dynamic transition threshold and collinear H_2-D_2 interactions above the dynamic threshold. Below threshold an initial angle representation is employed. It is found that the computed probabilities are in substantial agreement with exact quantum mechanical computations and represent a major improvement over quasi-classical results. At energies above threshold the first order and the classical semi-classical versions of the theory are applied. The results indicate fair agreement with quantum mechanical calculations, but no significant improvement over quasi-classical results. (auth)

Atomic Theory

Refer also to abstract 28573.

28128 (AED-CONF-74-085-003) A NEW MODEL FOR THE ATOM AND THE ATOMIC NUCLEUS. Schmidt, W. (SEE CODE-0743400 Badische Anilin- und Soda-Fabrik A. G. (BASF), Ludwigshafen am Rhein (F. R. Germany)). 1974. 6p. (In German). (CONF-740329-(Absts)). INIS.

From conference on atomic physics, physics of transient phenomena, molecular physics and plasma physics; Stuttgart, F. R. Germany (4 Mar 1974).

2 figs.; 5 refs.

A new relativistic model for the atom and the atomic nucleus is presented that leads to a proton of flat annular shape with a diameter of an elementary length and that allows the calculation of the fundamental constants hc/e^2, G.m(electron)/e^2, and the proton to electron mass ratio. (GE)

28129 EFFECT OF SHAPE OF ACTIVATION PULSE ON DECAY CURVE WITH CHANGE IN LIFETIME OF ACTIVATED STATE OF ATOMS. Malakhov, Yu. I. Tr. Mosk. Energ. Inst., Fiz.; No. 144, 124-126(1972). (In Russian).

Equations and curves of the relation between the concentration of activated atoms and the lifetime of the atoms at a studied level are analyzed. The results show the importance of controlling the activation flux parameters in an electron tube. For analysis of experimentally obtained decay curves an exponential model is needed. (TTT)

28130 VARIATIONAL PERTURBATION THEORY INVESTIGATIONS ON TWO–ELECTRON ATOMIC SYSTEMS. IV. NONRELATIVISTIC RESULTS FOR THE STATE $1s3s\ ^3S$. Aashamar, K.; Midtdal, J. (Institute of Physics, University of Oslo, Norway); Lyslo, G. J. Chem. Phys. 61: No. 4, 1345-1351 (15 Aug 1974).

We have applied the variational perturbation (HSK) procedure to the $1s3s\ ^3S$ state of the helium isoelectronic sequence. The nonrelativistic energies and corresponding total wavefunctions have been determined with estimated errors less than 5 parts in 10^{10} and one part in 10^4, respectively, for all $Z \geq 2$. For He in particular we report the value E = −4.1373781348 Rh, and correspondingly for Li^+, E = −9.5041529115 Rh. The values quoted are the best converged results for these states reported so far. We present the numerical results in tables and illustrative figures. (auth)

28131 COMPARISON OF NONRELATIVISTIC AND RELATIVISTIC PERTURBATION THEORY USING AS AN EXAMPLE THE CALCULATION OF THE ENERGY OF TWO–ELECTRON ATOMS. Gurchumeliya, A.D.; Safronova, U.I. Opt. Spectrosc. (USSR) 36: No. 4, 473-474 (Apr 1974).

Nonrelativistic perturbation theory is compared with relativistic perturbation theory for calculations of electronic structure of two–electron atoms (AIP).

28132 THEORY OF THE BLOCH–SIEGERT SHIFT. Ahmad, F.; Bollough, R. K. (Univ. of Manchester, Eng.). J. Phys., B (London); 7: No. 9, L275-L280(21 Jun 1974).

The method recently developed (Ahmad and Bullough, J. Phys. B. Atom. Molec. Phys.; 7: L147-51 (1974)) for treating Bloch-Siegert shift of the main resonance in a magnetic resonance experiment is successfully applied to the higher order resonances due to multiquantum transitions. A general analytical expression for the (2n + 1)th resonance is given. Results for the main and third order resonance in the low or vanishing low range of static magnetic fields are also reported. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 27893.

28133 HYDROSTATICS AND STEADY DYNAMICS OF SPATIALLY VARYING ELECTROMECHANICAL FLOW STRUCTURES. Jones, T.B. (Department of Electrical Engineering, Colorado State University, Fort Collins, Colorado 80521). J. Appl. Phys. 45: No. 4, 1487-1491 (Apr 1974).

The hydrostatic and steady laminar hydrodynamic equilibria of spatially varying electromechanical flow structures are investigated. Under certain conditions the relationship between the dielectric height of rise and the applied voltage is found to be double valued. It is found that one of the two equilibrium values is always unstable. This gives rise to the experimentally observed spontaneous rise of the fluid to the top of the structure, once a certain critical voltage is reached. Starting above this critical voltage with the structure completely filled and decreasing the applied voltage toward the critical value results in pinch—in failure at an intermediate point along the structure and trapping of dielectric fluid at the top. The simple mathematical model developed predicts all these phenomena, without recourse to tedious point—by—point surface force equilibrium determination. Experiments are reported which verify the results for the hydrostatic case. (auth)

28134 PLANE VISCOUS MAGNETOHYDRODYNAMIC FLOWS. Nath, V. L.; Chandna, O. P. Quart. Appl. Math.; 31: No. 3, 351-362 (Oct 1973).

An extension to MHD of an analysis of viscous incompressible nonconducting fluids by Martin [AMR 25 (1972), Rev. 2948] is presented. The fluid is assumed to be viscous incompressible and to possess infinite electrical conductivity, and the flow is two-dimensional. It is shown that if the streamlines (Ψ = constant) are nowhere parallel to the magnetic field lines (Φ = constant), then the governing MHD equations can be replaced by a new set of equations in Ψ, Φ. In the particular case where Ψ, Φ form a set of orthogonal curvilinear coordinates, it is proved that: (i) if the streamlines are straight lines but not parallel, then they must be concurrent; (ii) if the streamlines are involutes of a curve, then the streamlines are concentric circles. These general results are used to find solutions to vortex and source flow problems, which in this reviewer's opinion could have been found quite simply without all the preceding analysis. (Appl. Mech. Rev.)

28135 POSSIBILITY OF TWISTED MOTION IN MAGNETO-HYDRODYNAMICS. Gvelesiani, A. I. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 75: No. 1, 77-80 (Jul 1974). (In Russian).

The only condition of kinematic and dynamic possibility of movement of a viscous heterogeneous liquid with finite conductivity for the class of twisted motions is obtained. It is shown that some motions known in general hydrodynamics cannot exist in magneto-hydrodynamics. (auth)

28136 HALL EFFECTS ON GENERALIZED MHD COUETTE FLOW WITH HEAT TRANSFER. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay); Desai, G. A.; Gupta, A. S. Bull. Cl. Sci., Acad. Roy. Belg.; 60: No. 3, 332-345 (1974).

An analysis of a generalized magnetohydrodynamic Couette flow of a viscous, incompressible, electrically conducting fluid between two infinite parallel plates, on taking into account the transverse magnetic field and the Hall currents, is presented. Exact solutions for the velocity, the temperature, current density, the magnetic field, the skin-friction and the Nusselt number are derived. The velocity components, the current density, the magnetic field, and the skin-friction are shown on graphs and the values of the Nusselt number are entered in tables. During the course of the discussions, the effects of the Hartmann number, the Hall parameter and the axial pressure gradient are discussed. (auth)

28137 VISCOUS MFD LOW HARTMANN FLOW IN AN ANNULAR GAP: MAGNETIC PRANDTL NUMBER EXPANSION. Matalon, M.; Schweitzer, S. (Tel Aviv Univ., Israel). J. Franklin Inst.; 297: No. 4, 259-285 (Apr 1974).

The problem of a liquid conductor confined between two concentric cylindrical electrodes and driven electromagnetically is considered. The steady, three-dimensional viscous case is treated asymptotically in the limit of small magnetic Prandtl numbers. The zeroth-order solution to the coupled hydrodynamic and Maxwell equations yields the trivial solution of no motion in the limit of vanishing conductivity. Results for the first-order solution indicate two-dimensional effects in the electromagnetic field quantities while the first-order velocity is one-dimensional in the circumferential direction. Due to secular effects the solution is limited to values of small Hartmann numbers. The formulation of the second order and a limited solution for the velocity distribution indicates that the velocity field is three-dimensional having a cell-type structure. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 28190 and 28192.

28138 SECOND FIRE BALL. Arata, N. (Waseda Univ., Tokyo). Uchusen Kenkyu; 17: No. 4, 370-415(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamamatsu, Shizuoka, Japan (Dec 1971).

A problem concerning the second fire ball phenomena in high energy nuclear interaction is described. It is important to make clear the relation between the second fire ball event and SH quantum event. Emulsion chambers exposed in 1968 ~ 1969 and 1969 ~ 1970 were studied. Thirty eight small fire ball events were analyzed. The average number of emitted gamma-rays per one event was 8 ± 1. The decay pattern was isotropic. The mass Mγ which was transferred to the γ-ray of fire ball was 1.3 GeV/c^2 and the momentum Pγ^* of gamma-ray in the fire ball system was 160 MeV/c. The average of invariant mass mγ was 0.86 GeV/c^2. There were 21 large fire ball events (SH quantum events) analyzed. The average number of gamma rays was 30 ± 5. The decay was isotropic. Values of Mγ and Pγ^* were 8 GeV/c^2 and 400 ~ 500 MeV/c, respectively. The invariant mass number was about 3 ~ 4 GeV/c^2. The characteristic feature of the second fire ball events is that the decay is an isotropic. The second fire ball events can be separated into first fire ball and second fire ball by the methods of Shibata plot, relative four momentum and rapidity. The number of gamma-ray per event, Mγ and the invariant mass were obtained for the second fire ball events. It is concluded that the second fire ball events are not the same events as SH quantum events. (JA)

28139 REVIEW OF PARTICLE PROPERTIES. Chaloupka, V.; Bricman, C. (European Organization for Nuclear Research, Geneva (Switzerland)); Barbaro-Galtieri, A.; Chew, D. M.; Kelly, R. L.; Lasinski, T. A.; Rittenberg, A.; Rosenfeld, A. H.; Trippe, T. G.; Uchiyama, F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Phys. Lett., B; 50: No. 1, 1-198(Apr 1974).

This review of the properties of leptons, mesons, and baryons is an updating of Review of Particle Properties, Particle Data Group (Rev. Mod. Phys. 45, No. 2, Part II, Supplement (1973)). Data are evaluated, listed, averaged, and summarized in tables. (auth)

Electromagnetic

28140 RECENT EXPERIMENTAL RESULTS. Strauch, K. (Harvard Univ., Cambridge, MA). pp 1-25 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

The new experimental results on quantum electrodynamic processes and hadron production that have become available since the 1971 Cornell Conference are summarized. (LBS)

28141 ELECTROPRODUCTION IN THE RESONANCE REGION. Clegg, A. B. (Univ. of Lancaster, Eng.). pp 49-76 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

Several topics are discussed in detail: measurement of electroproduction at pion threshold; coincidence electroproduction measurements in the first resonance region; electroproduction measurements in the second resonance region; electroproduction from deuterium; quark models of photoproduction and electroproduction; and electroproduction of $\pi\Delta$ systems. (LBS)

28142 PHOTOPRODUCTION EXPERIMENTS. Fischer, H. M. (Univ., Bonn). pp 77-116 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

The new experimental achievements of photoproduction in the resonance region are discussed. The topics include: single pion photoproduction on nucleons; η photoproduction $\gamma + p \rightarrow \eta + p$; $\gamma + p \rightarrow K^+ + \Lambda$; $\gamma + p \rightarrow \pi + \Delta(1236)$; coherent pion photoproduction $\gamma + d \rightarrow \pi^0 + d$; and $\gamma + {}^3He \rightarrow p + d$ and $p + d \rightarrow \gamma + {}^3He$. (LBS)

28143 MULTI-BODY PRODUCTION OF MESONS. Meyer, H. (Univ. of California, Santa Cruz). pp 175-199 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

Cross-section data for photoproduction on proton and neutron targets are discussed with particular emphasis of possible differences between them. The few results on electroproduction which are available are examined as a function of Q^2 and W. Electroproduction data are then discussed in terms of the variables t and M_{x^*}. (LBS)

28144 TOTAL CROSS SECTIONS. Gabathuler, E. (Daresbury Nuclear Physics Lab., Lancashire, Eng.). pp 298-312 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

New results on total cross sections for photon interactions with hydrogen, deuterium, and complex nuclei are presented. (LBS)

28145 DIFFRACTIVE PROCESSES. Moffeit, K. C. (Stanford Univ., CA). pp 312-351 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

A brief review is first given of the properties and characteristics of diffraction scattering. The present knowledge of the diffractive process is summarized, with emphasis primarily on data of photoproduction and electroproduction of vector mesons. The following topics are covered: higher mass vector mesons; $\pi^+\pi^-$ line shape in dipion photoproduction on complex nuclei; energy dependence of the t-distribution for the diffractive photoproduction of vector mesons; and diffractive vector meson electroproduction. (LBS)

28146 TOTAL ν AND $\bar{\nu}$ CROSS SECTIONS AND INELASTIC PROCESSES. Franzinetti, C. (Univ. of Torino, Italy). pp 353-367 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

A review is given of experimental work at CERN and NAL to study the high-energy behavior of neutrino interactions both on nucleons and electrons. Some relevant details of the beam and detectors are given. The experimental results and theoretical interpretation are then presented. (LBS)

28147 MATRIX ELEMENT OF THE COMPTON EFFECT ON VECTOR MESONS. Fedorov, F. I.; Engel'mann, Z. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 3, 66-73(1974). (In Russian).

The general expression for the matrix element of Compton scattering on particles with spin 1, valid for any particle momentum and energy, random polarization of photons, and projection of meson spins to random directions, was examined. Its explicit form was obtained for different particular cases of orientation of the projection axis of the meson spin and all possible values of the same projection and also for different polarizations of the photon. The square of the modulus of the matrix element, summed through the polarization of both photons and also through the spin states of the incident or scattered mesons, was calculated. The differential cross section was obtained for the nonpolarized particles and the integral cross section was examined for high energies of the incident photon. The expressions for these cross sections differ from those obtained earlier by others. (tr-auth)

28148 INCLUSIVE PHOTOPRODUCTION OF PIONS, KAONS AND PROTONS AT 6 GeV. Burfeindt, H.; Buschhorn, G.; Genzel, H.; Heide, P.; Koetz, U.; Mess, K.-H.; Schmueser, P.; Sonne, B.; Vogel, G.; Wilk, B. H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Nucl. Phys., B; 74: No. 2, 189-210 (25 May 1974).

The invariant cross sections for inclusive photoproduction of charged pions, kaons and photons have been measured at DESY in the photon fragmentation region at a photon energy of 6 GeV. The π^+/π^- ratio is close to one at small values of the transverse momentum $p_\perp$ but increases with increasing values of $p_\perp$. This indicates that scaling is violated at large transverse momenta (or low missing masses). The same general behavior is also observed in the K^+/K^- ratio, although here the ratio is significantly larger than one even small transverse momenta. A comparison with preliminary data at 18 GeV supports this conclusion. The comparison further indicates that the largest violations of scaling occur with the "exotic" reaction $\gamma p \to K^- X$. The data are also analyzed according to the triple Regge model of inclusive reactions and the effective trajectories have been determined. (auth)

Weak

Refer also to abstract 28727.

28149 (BNL-19030) STUDY OF THE DECAY $K_2^0 \to \pi^+\pi^-\pi^0$. Hill, D. G.; Sakitt, M.; Snape, G.; Stevens, A.; Park, J.; Wang, L.; Slone, D.; Bunnell, K.; Mozley, R.; Odian, A.; Swanson, W.; Villa, F.; Liu, F. F. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. (CONF-740713-24). Dep. NTIS $4.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

Preliminary results are presented on the $K_2 \to \pi^+ + \pi^- + \pi^0$ decay are reported from an experiment designed to study both the three-pion and the semileptonic decay modes with high efficiency in order to minimize possible systematic errors and obtain reasonable statistics. Missing-mass-squared, momentum, probability, and kinetic energy distributions are found. (JFP)

28150 (EFI-41-73) DEPOLARIZATION OF μ^--MESONS IN DIFFERENT ELEMENTS. Dzhrbashyan, V. A. (Erevanskij Fizicheskij Inst. (USSR)). 1973. 13p. (In Russian). INIS.

A formula was derived for the depolarization of μ^- mesons during mesonic atom transitions, taking into consideration the value of the ratio of the fine structures of each cascade level at the widest. On the example of two distributions in the case of C it was shown that the residual polarization is only slightly sensitive with respect to the original population, not amenable as yet to precise calculation. The value $P/P_0 = 19\%$, obtained by use of the statistical distributions with consideration of the possible cascades and the specific value $\nu/2\gamma$, agrees well with subsequent measurements at JINR. A decrease of the residual polarization with increase of Z was observed. In connection with this it was observed that for heavy mesonic atoms the higher levels participate in the depolarization. From a comparison of theory with experiment it was concluded that in different elements the μ^- mesons are depolarized because of the interaction of spin with nonoriented orbits of the mesonic atoms. (tr-auth)

28151 OBSERVATION OF SINGLE-PION PRODUCTION BY A WEAK NEUTRAL CURRENT. Barish, S. J.; Cho, Y.; Derrick, M.; Hyman, L. G.; Rest, J.; Schreiner, P.; Singer, R.; Smith, R. P.; Yuta, H. (Argonne National Laboratory, Argonne, Illinois 60439); Koetke, D.; Barnes, V. E.; Carmony, D. D.; Garfinkel, A. F. Phys. Rev. Lett. 33: No. 7, 448-451 (12 Aug 1974).

In exposures of the Argonne National Laboratory 12-ft bubble chamber filled with hydrogen and deuterium to a neutrino beam, we have observed events consisting of (1) a single π^+ meson originating in the liquid, and (2) a proton with an e^+e^- pair pointing to it. Only a small fraction of these events can be ascribed to known reactions such as $np \to nn\pi^+$ and $np \to np\pi^0$. The remaining events, which correspond to a signal of about 4.5 standard deviations, we ascribe to the reactions $\nu p \to \nu n\pi^+$ and $\nu p\pi^0$. (auth)

28152 MEASUREMENT OF THE BRANCHING RATIO $\Gamma(K_L^0 \to \pi^+ \mu^- \bar{\nu})/\Gamma(K_L^0 \to \pi^+ e^- \bar{\nu})$. Williams, H.H.; Larsen, R.C.; Leipuner, L.B.; Sapp, W.W.; Sessoms, A.L.; Smith, L.W. (Brookhaven National Laboratory, Upton, New York 11973); Adair, R.K.; Turner, R. Phys. Rev. Lett. 33: No. 4, 240-243 (22 July 1974).

We present the results of a measurement of the $K_{\mu 3}^0/K_{e3}^0$ branching ratio, obtained from a study of K_L^0 decays using a multiwire-proportional-chamber spectrometer. The $K_{\mu 3}^0$ and K_{e3}^0 events were separated by muon range counters, and K_{e3}^0 events were separated from the K_{e3}^0 sample kinematically. From a sample of approximately 10000 $K_{\mu 3}^0$ and K_{e3}^0 events, we obtain a value of the branching ratio $\Gamma(K_{\mu 3}^0)/\Gamma(K_{e3}^0) = 0.662 \pm 0.037$. (auth)

28153 QUASI-ELASTIC NEUTRINO REACTIONS; FORM FACTORS. Derrick, M. (Argonne National Lab., IL). pp 369-388 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

A review is given of recent experiments on the following reactions: $\nu n \to \mu^- p$, $\bar{\nu} p \to \mu^+ \Lambda$, and $\nu p \to \mu^- \Delta^{++}$. In all cases, the data are discussed with particular reference to its bearing on the determination of the axial vector form factor. (LBS)

Strong (Baryon-induced)

Refer also to abstract 28298.

28154 (COO-2009-82) TECHNICAL PROGRESS REPORT OF THE INDIANA UNIVERSITY SPARK CHAMBER GROUP, DECEMBER 1, 1973-NOVEMBER 30, 1974. Brabson, B. B.; Crittenden, R. R.; Heinz, R. M.; Neal, H. A. (Indiana Univ., Bloomington (USA)). 1974. Contract AT(11-1)-2009. 11p. Dep. NTIS $4.00.

During the contract year beginning December 1, 1973 the Indiana University Spark Chamber Group was involved in a series of major experiments designed to study various aspects of strong interaction physics. An experiment was executed to search for the production of exotic mesons utilizing the SLAC Rapid Cycling Bubble Chamber. This experiment, which established an exotic production cross section limit of ~1μb, is being followed by another experiment by us which uses the SLAC streamer chamber to attain an order of magnitude greater sensitivity. An experiment was completed at the ZGS which studied the large $|t|$ polarization in p-p elastic scattering by utilizing an external proton beam on a polarized proton target. Equipment from this experiment is now being used to measure the depolarization parameter in p-p elastic scattering. An experiment to measure the small $|t|$ p-p polarization has been completed using the Argonne polarized beam. Also one is involved in a NAL experiment which studies forward elastic processes. Proposals were submitted and accepted by the SPS and NAL for experiments to study backward scattering and spin effects at high energy. Final results were published from our previous πp inclusive polarization experiment. (auth)

28155 (IFVE-SEF-73-30) ELASTIC SCATTERING OF π^-p, K^-p, AND $\bar{p}p$ AT 25 AND 40-GeV/c OF THE BOSON SPECTROMETER CERN-IFVE. Antipov, Yu. M.; Askoli, D.; Busnello, R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 22p. (In Russian). INIS.

Data are presented on the elastic scattering of π^-p, K-p, and $\bar{p}p$ at 25 and 40 GeV/c obtained on the 70-GeV proton synchrotron (IFVE). Differential scattering cross-sections and the slopes of the cones of diffraction dispersion for transmitted momenta of 0.07 to 0.80 $(GeV/c)^2$ are given. Data are compared with data obtained at lower energies. (tr-auth)

28156 (ORO-4449-2) STUDY OF THE NEUTRON-PROTON INTERACTION IN THE 300 TO 700 MeV ENERGY REGION. Annual Progress Report. Northcliffe, L. C. (Texas Agricultural and Mechanical Univ., College Station (USA). Research Foundation). 1974. Contract AT(40-1)-4449. 119p. Dep. NTIS $9.00.

Progress is reported from the LAMPF user group from Texas A & M University on investigations of neutron producing reactions, development of a monoenergetic neutron beam, studies of the n-p differential cross section for charge-exchange scattering, and studies of meson production in nucleon-nucleon collisions. (LBS)

28157 STRANGE-PARTICLE PRODUCTION IN NP INTERACTIONS AT 4-8 GeV/c. Ansorge, R.E.; Carter, J.R.; Charlesworth, J.A.; Neale, W.W.; Rushbrooke, J.G. (Cavendish Laboratory, Cambridge, England). Phys. Rev. D 10: No. 1, 32-44 (1 July 1974).

Results of a survey of strange-particle production in np interactions in the momentum range 4-8 GeV/c are presented. As details of 3-body events have already been published, the results for the most part concern 4- and 5-body events with no missing neutrals. Cross sections for production of the most prominent resonances are given, and the properties of certain quasi-3-body channels discussed and compared with the corresponding states produced in pp interactions. It is found that the Σ (1385) resonance is produced very strongly in unfitted topologies and certain statistical tensors for its production are shown to be in agreement with the predictions of the quark model. (auth)

28158 EVIDENCE FOR A NEW SCALING HYPOTHESIS IN HIGH-ENERGY COLLISIONS. Dao, F.T.; Hanft, R.; Lach, J.; Malamud, E.; Nezrick, F. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510); Davidson, V.; Firestone, A.; Lam, D.; Nagy, F.; Peck, C.; Sheng, A.; Poster, R.; Schlein, P.; Slater, W.; Dzierba, A. Phys. Rev. Lett. 33: No. 6, 389-391 (5 Aug 1974).

Single-particle distributions in transverse and longitudinal momenta have been studied in pp interactions at 300 GeV/c. By comparing these distributions for different multiplicities of produced particles and with published low-energy data, we put forth the hypothesis of a new type of scaling: The shape of distributions in p_T and p_L are independent of multiplicity and incident energy. (auth)

28159 SEARCH FOR A $\Delta-\Delta$ COMPONENT IN THE DEUTERON WAVE FUNCTION USING PD INTERACTIONS AT 5.55 GeV/c. Braun, H.; Brick, D.; Fridman, A.; Gerber, J.; Juillot, P.; Maurer, G.; Michalon, A.; Michalon-Mentzer, M. E.; Strub, R.; Voltolini, C. (Groupe des Chambres à Bulles à Hydrogène, Centre de Recherches Nucléaires, Strasbourg, France). Phys. Rev. Lett. 33: No. 5, 312-315(29 July 1974).

From a bubble-chamber experiment, we studied the $\bar{p}d \rightarrow p_s\bar{p}p\pi^-$, $p_s\bar{p}p\pi^-\pi^0$, $p_s\bar{n}p\pi^-\pi^-$ reactions at 5.55 GeV/c in order to see whether a $\Delta-\Delta$ component of the deuteron wave function can be observed in our data. This was achieved by searching for spectator $\Delta \rightarrow p_s\pi$ systems. We observed significant production of $\Delta \rightarrow p_s\pi$, a fraction of which is emitted in the backward laboratory hemisphere. The meaning of this high $\Delta \rightarrow p_s\pi$ production rate is discussed. (auth)

28160 INCLUSIVE π^0 PRODUCTION IN PP COLLISIONS AT 50-400 GeV/c. Carey, D.C.; Johnson, J.R.; Kammerud, R.; Peters, M.; Ritchie, D.J.; Roberts, A., Sauer, J.R.; Shafer, R.; Theriot, D.; Walker, J.K. (National Accelerator Laboratory, Batavia, Illinois 60510); Taylor, F.E. Phys. Rev. Lett. 33: No. 5, 327-330 (29 July 1974).

We have measured the single-photon cross section in the reaction $p + p \rightarrow \gamma +$ anything for incident proton momenta from 50 to 400 GeV/c and lab angles of 80, 100, and 120 mrad. It is shown that in the range $p_\perp = 0.3$ to 4.3 GeV/c, the derived π^0 invariant cross section can be factorized into a product of two functions, one in $p_\perp$ and the other in a new scaling variable $x_R = p^*/p_{max}^*$, where p^* is the total c.m. momentum of the π^0. (auth)

28161 UNIFIED DESCRIPTION OF SINGLE-PARTICLE PRODUCTION IN PP COLLISIONS. Carey, D.C.; Johnson, J.R.; Kammerud, R.; Peters, M.; Ritchie, D.J.; Roberts, A.; Sauer, J.R.; Shafer, R.; Theriot, D.; Walker, J.K. (National Accelerator Laboratory, Batavia, Illinois 60510); Taylor, F.E. Phys. Rev. Lett. 33: No. 5, 330-333 (29 July 1974).

We show that, over a very wide range of c.m. angles, energies, and transverse momenta, the invariant cross sections for inclusive production of hadrons in pp collisions show a very simple behavior when expressed in terms of a new radial scaling variable $x_R \equiv p^*/p_{max}^*$, where p^* is the total c.m. momentum of the hadron. (auth)

28162 PARTICLE SPECTROSCOPY. Samios, N. P. (Brookhaven National Lab., Upton, NY). pp 93-150 of Past Decade in Particle Theory. Sudarshan, E. C. G. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

The data concerning the meson and baryon resonances are required. Special attention is paid to the newer resonances and the many outstanding questions associated with the more recently observed resonances. The relation of the observed resonance spectrum and the multiplets structure required by the theoretical symmetry schemes is reviewed. The baryon resonances are also placed into possible Regge families. (auth)

28163 STUDY OF THE PROPERTIES OF THE QUASI TWO-PARTICLE REACTION IN PROTON-PROTON INTERACTIONS. Takibaev, Zh. S.; Boos, E. G.; Temiraliev, T. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 5-10(1974). (In Russian).

The angular distribution of the decay particles from two-particle reaction $pp \rightarrow N\Delta_{1236}$, $pp \rightarrow \Delta_{1236}^{++}\Delta_{1236}^{0}$, $pp \rightarrow \Delta_{1236}N_{1518}$, and $pp \rightarrow \Delta_{1236}N_{1688}$ was reported. The dependence of the cross sections of these processes on the primary momentum was analyzed. It was shown that these cross sections have different behaviors as a function of the quantum resonance number. The experimental results were compared with the prediction of different theoretical models. (tr-auth)

28164 PROMPT ISOTOPES OF HELIUM IN INTERACTIONS OF HIGH-ENERGY PARTICLES WITH THE NUCLEI OF PHOTOEMULSIONS. Boricenko, A. L.; Goryachikh, A. A.; Kazanskaya, A. P.; Morozova, P. V.; Takibaev, Zh. S.; Titova, N. S. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 65-67(1974). (In Russian).

The characteristics of the formation of He nuclei with momenta greater than 800 MeV/c during the interaction of 60-GeV pions and 67-GeV protons with the heavy nuclei of emulsions were studied. The average characteristics of the ejection of He isotopes and their energy distribution were reported. (tr-auth)

28165 BACKGROUND OF THE RESONANCE STATE IN SIMULATED THREE-BEAM pn INTERACTIONS AT A MOMENTUM OF 19.2 GeV/c. Boos, E. G.; Zhautykov, B. O.; Mosienko, A. M. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 73-74(1974). (In Russian).

The results of the simulation of the three-beam pn interactions with momentum of 19.2 GeV/c in deuterium bubble chambers were discussed. The background distribution of the effective mass of different combinations of particles was reported and compared with curves calculation from invariant phase volume. The change of the contribution of the background combination of particles, selected in agreement with the maximum momentum method, was evaluated. (tr-auth)

28166 ANALYSIS OF COSMIC RAY DATA ON NUCLEON-NUCLEUS COLLISIONS AND ITS IMPLICATION ON HIGH ENERGY BEHAVIOR OF NUCLEON-NUCLEON TOTAL CROSS SECTION. Ganguli, S. N.; Raghavan, R.; Subramanian, A. (Tata Inst. of Fundamental Research, Bombay). Pramana; 2: No. 6, 348-358 (Jun 1974).

From existing cosmic ray measurements of the inelastic collision cross sections of nucleons on nuclei of carbon, iron, and lead in the range of energies 10^2 to 10^4 GeV as well as the measurements of cross sections on air nuclei in the extensive air shower (EAS) regions (10^5 to 10^8 GeV), one concludes that the Glauber multiple scattering theory is adequate to account for the data. Recent suggestion of Maor and Nussinov to parametrize the nucleon-nucleon total cross section with a component growing proportional to $\ln^2 E$ (E is the incident energy) is at variance with the EAS data. However the data are consistent with a nucleon-nucleon total cross section rising no faster than ln E in these energy regions. (auth)

28167 ANALYSIS OF PROTON-CARBON INELASTIC CROSS SECTIONS MEASURED IN SATELLITE EXPERIMENT AND UPPER LIMIT ON PRIMARY COSMIC RAY DEUTERON FLUX IN THE ENERGY RANGE 20 TO 600 GeV. Ganguli, S. N.; Raghavan, R.; Subramanian, A. (Tata Inst. of Fundamental Research, Bombay). Pramana; 2: No. 6, 341-347(Jun 1974).

An analysis was made of the experimental results of Akimov et al on the inelastic cross sections of proton on proton and carbon targets in the energy range 20 to 600 GeV obtained from artificial earth satellites. It is found that an upper limit of 4 at 95% confidence level can be set on the fraction of deuterons relative to the flux of protons in the primary cosmic radiation at energies in the range 20 to 60 GeV. There is an indication for a rise of (29 ± 7) mb in the inelastic cross section of proton against carbon in the energy range of 200 to 600 GeV over and above what is expected from Glauber's theory. If this rise has to be interpreted as due to contamination from cosmic ray deuterons, the fraction of deuterons relative to protons needed is (15 ± 4)% in this energy region. (auth)

28168 CHARACTERISTICS OF THE EXCLUSIVE REACTION IN PROTON-PROTON INTERACTION AT A MOMENTUM OF 19.1 GeV/c. Takibaev, Zh. S.; Boos, E. G.; San'ko, L. A.; Zaitsev, K. G. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 11-17 (1974). (In Russian).

The properties of the longitudinal and transverse momentum of secondary protons and pions from four-beam pp interactions at momentum of 19.1 GeV/c in the 2 m CERN ISR were studied. It was shown that in the exclusive reaction the generation of pions occurs primarily by the isobar mechanism. (tr-auth)

28169 CROSS SECTIONS AND MULTIPLICITY DISTRIBUTIONS FOR $\bar{p}p$ ANNIHILATIONS AT 4.6 GeV/c. Everett, D.; Grossmann, P.; Mason, P.; Muirhead, H. (Liverpool Univ. (UK)). Nucl. Phys., B; 73: No. 3, 449-464(11 May 1974).

Channel cross sections have been determined for $\bar{p}p$ annihilations into final states containing 3 to 9 pions at 4.6 GeV/c. The moments of both the charged and neutral pion multiplicity distributions are presented and model predictions are critically examined. (auth)

28170 ANTIPROTON CHARGE EXCHANGE ON PROTONS AT 25 AND 35 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kakauridze, D. B.; Kachanov, V. A.; Postoev, V. E.; Prokoshkin, Yu. D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). Nucl. Phys., B; 73: No. 3, 401-409(11 May 1974).

Cross sections for $\bar{p}p \rightarrow \bar{n}n$ at 25 and 35 GeV/c have been measured. The cross sections decrease with increasing momentum as $1/p^2$. A narrow peak is observed in the momentum transfer interval $0 \leq -t \lesssim 0.02$ $(GeV/c)^2$ in the differential cross sections.

Neither ρ nor A_2 exchange contribute to the process in the investigated energy range. (auth)

Strong (Meson-induced)

28171 (EFI-26-73) POSSIBILITY OF MEASURING ρ^0-PHOTOPRODUCTION TOTAL CROSS SECTION WITH IFVE ACCELERATOR ELECTRON BEAM WITHOUT A MAGNETIC SPECTROMETER. Alikhanyan, A. I.; Bayatyan, G.; Vartanyan, G. S.; Knyazyan, S. G.; Margaryan, A. T. (Erevanskij Fizicheskij Inst. (USSR)). 1973. 12p. (In Russian). INIS.

The possibility of measuring the total cross section for the photoproduction of ρ^0 mesons on hydrogen and nuclei in the energy range from 10 to 40 GeV at the electron beam of the Serpukhov proton accelerator was examined. A specific experimental installation without use of the magnetic spectrometer was proposed. (tr-auth)

28172 (IFVE-SEF-73-57) $\pi^- p \to \eta^0 n$ REACTION IN THE MOMENTUM RANGE UP TO 50 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kakuridze, D. B.; Kachanov, V. A.; Kut'in, V. M.; Prokotskin, Yu. D.; Razuvaev, E. A.; Semenov, V. K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 28p. (In Russian). INIS.

The differential cross sections of the reaction $\pi^- p \to \eta^0\eta$, $\eta^0 \to 2\gamma$ were measured in the energy region from 20 to 50 GeV at transmitted 4-momenta of $-t \lesssim 3$ (GeV/c)^2. The cross sections are decreased by power transforms with increase of the momentum of mesons. The scattering cone first slowly converges. At $-t \simeq 1.1$ (GeV/c)^2 the differential cross sections pass through a mildly sloping minimum. The parameters of the A_2 trajectory, which is essentially nonlinear, were determined. (tr-auth)

28173 (ITEF-46) INVESTIGATION INTO ρ-MESON PRODUCTION ON CARBON FOR DETERMINING CROSS SECTION OF N-INTERACTION. Aref'ev, A. V.; Bayukov, Yu. D.; Efremenko, V. I.; Zaitsev, Yu. M.; Kozodaev, M. S.; Kuleshov, L. N.; Aleksin, G. A.; Suchkov, D. A.; Korotkikh, V. D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 8p. (In Russian). INIS.

The preliminary results of the study of the (π^-, ρ^0) reaction on ^{12}C at $P_{\pi^-} = 3.72$ GeV/c and $0.05 < |t'| < 0.5$ (GeV/c)^2. By use of the value of N_{eff} obtained, the total interaction cross section of ρ mesons with the nucleons $\sigma_{\rho N}$ at $P_\rho \sim 3.6$ GeV/c was determined in the Glauber–Margolis model. Within the limits of error the value agreed with the value $\sigma_{\rho N}$ obtained from the process of photoproduction of ρ mesons on nuclei. (tr-auth)

28174 MASS DEPENDENCE OF THE MOMENTUM–TRANSFER DISTRIBUTIONS IN $\pi^+ p \to p8\pi$ AT 11.0 GeV/c. Yost, G.P. (Department of Physics, University of California, Berkeley, California 94720 and Department of Physics, The Florida State University, Tallahassee, Florida 32306); Morris, W.A.; Albright, J.R.; Lannutti, J.E. Phys. Rev. D 10: No. 1, 1-8 (1 July 1974).

Bubble–chamber data for the reaction $\pi^+ p \to p8\pi$ at 11.0 GeV/c have been analyzed from the standpoint of a new procedure which emphasizes the mass dependence of the momentum–transfer distribution. The technique shows a promise of resolving different types of production mechanisms. It is shown that analysis of the structure observed in these variables allows discrimination among some types of models for this extraordinarily complex reaction. (auth)

28175 MEASUREMENT OF THE $\pi^- p$ ELASTIC SCATTERING CROSS SECTION NEAR 180° BETWEEN 600 AND 1280 MeV/c. Richards, T.J.; Crabb, D.G.; Keller, R.; O'Fallon, J.R. (Physics Department, Saint Louis University, Saint Louis, Missouri 63103); Ott, R.J.; Trischuk, J.; Va'vra, J.; Schroeder, L.S. Phys. Rev. D 10: No. 1, 45-64 (1 July 1974).

Differential cross sections for $\pi^- p$ elastic scattering over the angular range 155 to 177° in the center–of–mass system have been measured at 33 incident pion momenta in the range 600 to 1280 Mev/c. The experiment which was performed at the Bevatron at the Lawrence Berkeley Laboratory, employed a liquid hydrogen target, a double–arm spectrometer, and standard counter techniques to detect the elastic events. The data from this experiment are compared to all other published data in the momentum region. The over–all agreement is good. The data of this experiment are also compared with the results of the recent phase–shift analysis by Almehed and Lovelace. In the momentum region between 700 and 900 Mev/c, the slope of the backward angular distribution goes rapidly through zero from negative to positive, and the magnitude of the differential cross section falls by more than a factor of 10. Momentum–dependent structure is seen in the extrapolated differential cross sections at 180°. Two prominent dips in the 180° differential cross sections appear at 880 and 1150 Mev/c. This structure is discussed in terms of a direct–channel resonance model that assumes only resonant partial waves are contributing to the cross sections for large scattering angles. (auth)

28176 NUCLEON–NUCLEON SCATTERING NEAR 50 MeV. III. ANALYSIS OF NEW DAVIS np DIFFERENTIAL CROSS–SECTION DATA. Bryan, R. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544); Binstock, J. Phys. Rev. D 10: No. 1, 72-77 (1 July 1974).

New Davis np differential cross–section data at 50 MeV are phase–shift analyzed together with the other world pp and np data in the laboratory scattering energy range 47.5 to 60.9 MeV. Various combinations of the np $d\sigma/d\Omega$ data, taken by groups at Davis, Oak Ridge, and Harwell, are included in the analysis and are found to affect mainly just the phase paramenter δ ($^1P_1$). We argue that the Harwell only, or Harwell + Oak Ridge + Davis data analyses call for a strong long–range potential such as might come from ABC (Abashian–Booth–Crowe) exchange, while the Davis only or Davis + Oak Ridge data analyses are compatible with ordinary (non–ABC) meson–theoretical models. We urge that more precise np absolute $d\sigma/d\Omega$ data be taken, to 1 of 2% accuracy, especially at far forward angles. (auth)

28177 STUDY OF THE REACTIONS $\bar{K}^0 p \to \Lambda\pi^+$ AND $\bar{K}^0 p \to \Sigma^0\pi^+$ FROM 1 TO 12 GeV/c. Yamartino, R.J.; Brandenburg, G.W.; Johnson, W.B.; Leith, D.W.G.S.; Loos, J.S.; Luste, G.J.; Matthews, J.A.J.; Moriyasu, K.; Smart, W.M.; Winkelmann, F.C. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 1, 9-24 (1 July 1974).

Cross sections, differential cross sections, and hyperon polarization results are presented for the reactions $K^0 p \to \Lambda\pi^+$ and $K^0 p \to \Sigma^0\pi^+$ in the momentum interval 1 to 12 GeV/c. Emphasis is placed on the comparison of Λ and Σ channels, and on the momentum dependences of the data. In particular, the Λ polarization data are consistent with being independent of energy above 2 GeV/c; and the slopes of the forward cross sections are found to increase toward the slope values for the line–reversed reactions $\pi p \to K(\Lambda,\Sigma)$ as energy increases. (auth)

28178 MEASUREMENT OF THE POLARIZATION PARAMETER FOR THE REACTION $\pi^- p \to \pi^0 n$ BETWEEN 1.03 AND 1.79 GeV/c. Shannon, S.R.; Anderson, L.; Bridgewater, A.; Chaffee, R.; Chamberlain, O.; Dahl, O.; Fuzesy, R.; Gorn, W.; Jaros, J.; Johnson, R.; Kenney, R.; Nelson, J.; O'Keefe, G.; Oliver, W.; Pollard, D.; Pripstein, M.; Robrish, P.; Shapiro, G.; Steiner, H.; Wahlig, M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 33: No. 4, 237-240 (22 July 1974).

The polarization parameter for the reaction $\pi^- p \to \pi^0 n$ has been measured at five incident beam momenta between 1.03 and 1.79 GeV/c. The results are compared with predictions of recent phase–shift analyses. (auth)

28179 INTERFERENCE BETWEEN ρ AND ω PRODUCTION IN $\pi^+ N \to \pi^+\pi^- N$ AT 3, 4, AND 6 GeV/c. Kramer, S.L.; Ayres, D.S.; Diebold, R.; Greene, A.F.; Pawlicki, A.J.; Wicklund, A.B. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 33: No. 8, 505-508 (19 Aug 1974).

The ρ–ω interference patterns observed in the reactions $\pi^- p \to \pi^+\pi^- n$ and $\pi^+ n \to \pi^+\pi^- p$ are used to measure the relative phases between ρ and ω production amplitudes. The interference is observed to be largely constructive (destructive) for the $\pi^- - (\pi^+ -)$ induced reaction in both natural– and unnatural–parity exchange amplitudes. This sign of the interference agrees with that predicted form exchange–degenerate π–B trajectories, but disagrees with the corresponding prediction for the natural–parity amplitudes using exchange–degenerate ρ–A_2 trajectories. (auth)

28180 EFFECT OF THE DECAY OF POLARIZED NUCLEON ISOBARS ON THE DISTRIBUTION OF SECONDARY PARTICLES IN FOUR-BEAM $\pi^- p$ INTERACTIONS. Takibaev, Zh. S.; Golyak, I. G.; Kosmachev, O. S.; Rus'kin, V. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 45-55(1974). (In Russian).

It was shown that the decays of polarized nucleon isobars significantly affects the angular and momentum distribution of secondary particles in four-beam interactions at $p_\pi = 10$ GeV/c. (tr-auth)

28181 PARTIAL-WAVE ANALYSIS OF THE REACTION $K^- p \to K\Delta$ (1230) IN THE ENERGY REGION 1915-2170 MeV. Litchfield, P. J.; Hemingway, R. J.; Baillon, P. (European Organization for Nuclear Research, Geneva (Switzerland)); Albrecht, A.; Putzer, A. (Heidelberg Univ. (F.R. Germany). Inst. fuer Hochenergiephysik). Nucl. Phys., B; 74: No. 1, 39-58(18 May 1974).

A partial-wave analysis has been carried out on the reaction $K^- p \to K^-\Delta^+$ (1230) $\to K^- p\,\pi^0$ in the center of mass energy region 1915-2170 MeV. The $\Sigma(2030)$ is observed with an amplitude at resonance of 0.16 ± 0.03. Strong formation of the $\frac{3}{2}^-$ $\Sigma(1940)$ is also indicated. (auth)

28182 PARTIAL-WAVE ANALYSIS OF THE REACTION $K^-p \to \Lambda(1520)\pi$ IN THE ENERGY REGION 1915-2170 MeV. Litchfield, P. J.; Hemingway, R. J.; Baillon, P. (European Organization for Nuclear Research, Geneva (Switzerland)); Putzer, A.; Schleich, H. (Heidelberg Univ. (F.R. Germany). Inst. fuer Hochenergiephysik). Nucl. Phys., B; 74: No. 1, 19-38(18 May 1974).

A partial-wave analysis has been carried out on the reaction $K^-p \to \Lambda(1520)\pi \to K^-p\pi^0$. The $\Sigma(2030)$ is observed with an amplitude at resonance of 0.14 ± 0.03. Evidence is also presented for the formation of the $\frac{3}{2}^-\Sigma(1940)$. (auth)

28183 PARTIAL-WAVE ANALYSIS OF THE REACTION $K^-p \to \Lambda(1815)\pi$ BETWEEN THRESHOLD AND 2170 MeV. Litchfield, P. J.; Hemingway, R. J.; Baillon, P. (European Organization for Nuclear Research, Geneva (Switzerland)); Albrecht, H.; Burkhardt, E. (Heidelberg Univ. (F.R. Germany). Inst. fuer Hochenergiephysik). Nucl. Phys., B; 74: No. 1, 12-18(18 May 1974).

The reaction $K^-p \to \Delta(1815)\pi^0 \to K^-p\,\pi^0$ is found to be dominated by the formation of the $\frac{7}{2}^+\Sigma(2030)$ with an amplitude at resonance of 0.18 ± 0.04. (auth)

28184 CORRELATIONS IN PARTICLE PRODUCTION IN PION-PROTON INTERACTIONS AT 40 GeV/c. Abdurakhmanov, E.; Basina, A.; Chasnikov, I.; Streltsov, I.; Takibayev, Zh.; Vinitskij, A.; Yeremenko, L. (AN Kazakhskoj SSR, Alma-Ata. Inst. Fiziki Vysokikh Ehnergij); Balea, O.; Boldea, V.; V.; Felea, S. Nucl. Phys., B.; 74: No. 1, 1-11(18 May 1974).

Results of the investigation of some correlation effects in π^-p interactions at 40 GeV/c incident momentum are given. On the basis of 2000 events the dependence of the transverse momenta of π^+ and π^- mesons on the longitudianl momenta was obtained, as well as two-particle distributions for various pion pairs, and correlation functions $C(y_1, y_2)$ and $R(y_1, y_2)$. For $\pi^+\pi^-$ pairs $R(0,0) = 0.65 \pm 0.07$ and the correlation length is $L = 1.8 \pm 0.2$ for $-1 \le y_1, y_2 \le 1$. For $\pi^+\pi^+$ and $\pi^-\pi^-$ pairs $R(0,0) = 0.26 \pm 0.10$. Comparison of these results with proton-proton data at 200 GeV and at ISR energies suggests that limiting behaviour in two-particle distributions $R(y_1, y_2)$ for π^-p interactions is already reached at 40 GeV. (auth)

28185 NEGATIVE PION CHARGE EXCHANGE SCATTERING ON PROTONS IN THE MOMENTUM RANGE 20-50GeV/c. Bolotov, V. N.; Isakov, V. V.; Kachanov, V. A.; Kakauridze, D. B.; Kutjin, V. M.; Prokoshkin, Yu. D.; Razuvaev, E. A.; Rybakov, V. G.; Semenov, V. K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). Nucl. Phys., B; 73: No. 3, 365-386(11 May 1974).

Differential cross sections for charge exchange $\pi^-p \to \pi^0n$ have been measured for momenta up to 50 GeV/c. The cross section falls as a power of energy. The forward scattering cone shrinks with increasing energy. The cross section for charge exchange at zero angle drops with momentum as $p^{-0.81 \pm 0.05}$. The charge exchange cross section in the region of the second maximum decreases as $p^{-2.8 \pm 0.1}$. The trajectory is described by a linear function $\alpha(t) = 0.56\ 0.97t$ in the interval $0 < -t < 1.5$ $(GeV/c)^2$. (auth)

28186 REACTION $\pi^-p \to eta^0n$ AT MOMENTA UP TO 50 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kakauridze, D. B.; Kachanov, V. A.; Kutjin, V. M.; Prokoshkin, Yu. D.; Razuvaev, E. A.; Semenov, V. K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). Nucl. Phys., B; 73: No. 3, 387-400(11 May 1974).

Differential cross sections for $\pi^-p \to \eta^0n$, $\eta^0 \to 2\gamma$ have been measured from 20 to 50 GeV for four-momentum transfers $-t \le 3(GeV/c)^2$. The cross sections decrease as a power of momentum and the forward scattering cone shrinks slowly. The parameters of the A_2 trajectory, which is considerably non-linear, have been determined. (auth)

28187 A STUDY OF THE HYPERCHARGE EXCHANGE REACTIONS $K^-p \to 1\text{-}\frac{1}{2}^+$ AT AN INCOMING MOMENTUM OF 4.25 GeV/c. de Groot, A. J.; Hoogland, W.; Jongejans, B.; Kluyver, J. C.; Massaro, G. G. G. (Amsterdam Univ. (Netherlands). Zeeman Lab.); Metzger, W. J.; Tiecke, H. G. J. M.; Timmermans, J. J. M. (Katholieke Universiteit Nijmegen (Netherlands). Fysisch Lab.). Nucl. Phys., B; 74: No. 1, 77-101(18 May 1974).

Results are reported of a study of the hypercharge reactions $K^-p \to \omega\Lambda$ (Ia), $K^-p \to \phi\Lambda$(Ib), $K^-p \to \phi\Sigma^0$(Ic), $K^-p \to \rho^0\Lambda$ (Id), $K^-p \to \rho^0\,\Sigma^0$ (Ie), $K^-p \to \rho^-\Sigma^+$ (If) in a 12 events/μb bubble chamber experiment using K^- mesons of 4.25 GeV/c momentum. Total and differential cross sections are presented as well as the density matrix elements of the peripherally produced vector meson and (except for reaction (If)) the hyperon polarization. For reactions (Ia) and (Ib) an amplitude analysis is performed. The mass and the width of the ρ_3, ϕ- and f-meson have been determined. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 28638.

28188 (COO-2009-57a) THEORETICAL PARTICLE PHYSICS. Progress Report, December 1, 1972—November 30, 1973. Chu, S. Y.; Hendry, A. W.; Lichtenberg, D. B. (Indiana Univ., Bloomington (USA). Dept. of Physics). [nd]. Contract AT(11-1)-2009. 14p. Dep. NTIS $4.00.

Work in theoretical particle physics was done in a variety of subjects. A major effort went into a phenomenological description of high energy elastic scattering. Using an s-channel description in which the partial wave amplitudes were parametrized as smooth functions in impact parameter space, good fits to the differential cross sections and polarizations were obtained, including the πp and pp data of the Indiana University spark-chamber group (Task A of this Contract). Phenomenological work was also done in characterizing strong-interaction resonances. Empirical relations among the masses, widths, and elasticities of resonances were found, and these relations were partially accounted for in terms of the Veneziano model. Further work on resonances was the development of a new parametrization which emphasizes the position of the pole in the relevant S-matrix. Finally, a new approach to five-dimensional general relativity was proposed. (auth)

28189 LEPTON NUMBER AS THE FOURTH "COLOR". Pati, J.C. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742); Salam, A. Phys. Rev. D 10: No. 1, 275-289 (1 July 1974).

Universal strong, weak, and electromagnetic interactions of leptons and hadrons are generated by gauging a non—Abelian renormalizable anomaly—free subgroup of the fundamental symmetry structure $SU(4)_L \times SU(4)_R \times SU(4')$, which unites three quartets of "colored" baryonic quarks and the quartet of known leptons into 16—folds of chiral fermionic multiplets, with lepton number treated as the fourth "color" quantum number. Experimental consequences of this scheme are discussed. These include (1) the emergence and effects of exotic gauge mesons carrying both baryonic as well as leptonic quantum numbers, particularly in semileptonic processes, (2) the manifestation of anomalous strong interactions among leptonic and semileptonic processes at high energies, (3) the independent possibility of baryon—lepton number violation in quark and proton decays, and (4) the occurrence of (V+A) weak—current effects. (auth)

28190 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 16, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 100p.

28191 CORRELATIONS IN INCLUSIVE REACTIONS FROM MULTIPERIPHERAL MODELS WITH ISOSPIN STRUCTURE. Baier, R.; Widder, F. (Univ., Graz, Austria). Acta Phys. Austr.; 38: No. 1, 23-40(Aug 1973).

The correlations among charged pions are investigated in the framework of specific multiperipheral models which conserve isospin in the s channel. The influence of diffractive dissociation on the correlation parameters is examined quantitatively. (auth)

28192 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 17, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 85p.

28193 PAST DECADE IN PARTICLE THEORY. Conference Held in Austin, Texas, April 14—17, 1970. Sudarshan, E. C. G.; Ne'eman, Y. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1973). 827p. (CONF-700424-). $42.00.

The conference included 20 papers. Separate abstracts were prepared for all papers. (JFP)

For abstracts of individual papers see: 28162, 28194, 28244—28246, 28259—28261, 28293, 28301, 28302, 28308, 28313, 28314, 28613—28616, 28637, and 28638.

28194 DISPERSION THEORY AND THE COMPLEX J-PLANE. Mandelstam, S. (Univ. of California, Berkeley). pp 295-343 of Past Decade in Particle Theory. Sudarshan, E. C. G. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

A review is given of some of the basic ideas of dispersion theory and examples of the successful applications of the theory in understanding elementary particle reactions are presented. The principles of Regge theory are often discussed including phenomenological applications and the composite nature of Regge recurrences.

Finally, the prospects for dynamical calculations based on dispersion relations and Regge theory are discussed. (auth)

Electromagnetic

Refer also to abstract 28143.

28195 (DESY-74/26) ISOSPIN BOUNDS AND BOSE CONDENSATION IN e^+e^- ANNIHILATION. Devenish, R. C. E.; Koller, K.; Walsh, T. F.; Schiller, D. H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Jun 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

Isospin bounds for two particle correlations in $e^+e^- \to \gamma \to N\pi$, discuss the physical significance of saturation of the upper bound and present various multiplicity distributions for this case. (auth)

28196 FIXED-POLE RESIDUES AND THE DIFFRACTIVE LIMIT IN VIRTUAL COMPTON SCATTERING: A SIMPLE APPROACH. Goldberg, H. (Department of Physics, Northeastern University, Boston, Massachusetts 02115 and Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 1, 340-343 (1 July 1974).

We propose as an ansatz the constancy of the ratio ξ of the nondiffractive pieces of $\nu W_2{}^n$ and $\nu W_2{}^p$ for $\omega \gtrsim 12$. This enables us to obtain a simple relation between the experimental data and the fixed-pole residues R_p, R_n, as well as some constraints on the constant $\nu W_2{}^p = \lim_{\omega\to\infty} \nu W_2{}^{p,n}$. For $\xi = 2/3$ and $R_p = 1$, we obtain $R_n = 0.37$ and $\nu W_2{}^p \simeq 0.20$. (auth)

28197 CHARGE TRANSFER AND FLUCTUATIONS IN DEEP-INELASTIC ELECTROPRODUCTION. Newmeyer, J.L.; Sivers, D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 1, 204-218 (1 July 1974).

We consider what can be learned about the nature of electroproduction from a measurement of the charge transferred across a surface in momentum space in the hadronic final state. The mean charge transfer as a function of rapidity, $\langle u(y) \rangle$, can be used to test quark-parton assumptions. The mean square charge transfer, $\langle u^2(y) \rangle$, can be measured and compared with an inclusive single-particle distribution in order to explore the possibility of new types of clustering effects in the current fragmentation region. (auth)

28198 DUAL MODEL WITH MANDELSTAM ANALYTICITY FOR DEEP-INELASTIC ELECTROPRODUCTION AND ANNIHILATION. Schierholz, G.; Schmidt, M.G. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 1, 175-186 (1 July 1974).

We present a dual model for virtual Compton amplitude which satisties the current-alegbra constraints and exhibits Mandelstam analyticity. Mandelstam analyticity is crucial for making any contact to the deep-inelastic annihilation region, i.e., s, q^2, $q^2 \to +\infty$, and is accomplished by introducing nonlinear trajectories. The scaling properties of this model are mainly shaped by the current-algebra constraints. In terms of dual variables, the scaling limit occurs from the same configuration as the current-algebra fixed pole. We deal with two different choices of the trajectory. One gives back all the nice properties of the original Veneziano model. The other is inspired by the experimental finding of power behavior in large-angle scattering and its theoretical elucidation, the interchange model which requires asymptotically constant trajectories. The first choice leads to a light-cone representation and exhibits a new relation between the large-x behavior of the deep-inelastic annihilation structure function and the asymptotic behavior of the electromagnetic $(2^+) \to (1^-)$ transition form factor. (auth)

28199 CALCULATION OF ANOMALOUS MAGNETIC MOMENTS OF NUCLEONS. Deo, B.B.; Singh, L.P. (Physics Department, Utkal University, Bhubaneswar-4, Orissa, India). Phys. Rev. D 10: No. 1, 308-314 (1 July 1974).

A sideways dispersion relation is used to calculate the anomalous magnetic moments of nucleons. The absorptive parts for all energies are obtained as extrapolations of the one-pion-one-nucleon intermediate state in the elastic region having proper threshold behavior and an assumed Regge behavior at high energies. The calculated values are $\mu_S = -0.06$ and $\mu_V = 1.81$. (auth)

28200 TRIDENT ELECTROPRODUCTION OF MUON PAIRS IN DEEP-INELASTIC INCLUSIVE REACTIONS. Koul, B.L.; Pandita, P.N.; Singh, Y. (Department of Physics, Kashmir University, Srinagar-6 India). Phys. Rev. D 10: No. 1, 298-307 (1 July 1974).

We explore the possibility of deriving the scaling in the field-theoretic parton model for the process $e + \mu^- + \mu^+ +$"anything" with the electron, as well as the muon pair detected. The cross section for the above process is analyzed in terms of invariant structure functions. We show that the contribution of the absorptive part of the amplitude to the structure functions scales in the parton model. This type of process may provide another domain for comparison of the models of highly inelastic electrodynamic processes. In particular, so far as scaling is concerned, the results of the parton model are similar to those obtained from bilocal algebra of currents. (auth)

28201 POSSIBLE EVIDENCE FOR QUARK SUBSTRUCTURE FROM ELECTRON-POSITRON COLLIDING-BEAM EXPERIMENTS. West, G.B. (Department of Physics, Institute for Theoretical Physics, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 1, 329-333 (1 July 1974).

By endowing quarks with a size and a small anomalous magnetic moment, it is shown that the rise in the ratio σ ($e^+e^- \to$ all hadrons)/σ ($e^+e^- \to \mu^+\mu^-$) with center-of-mass energy can be simply explained while leaving the observed scaling phenomenon in deep-inelastic electron scattering intact. Speculations and tests of the model are discussed. (auth)

28202 PROTON-PROTON BREMSSTRAHLUNG: COULOMB EFFECT. Heller, L.; Rich, M. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. C 10: No. 2, 479-493 (Aug 1974).

A nonrelativistic potential model calculation of proton-proton bremsstrahlung is carried out in which the Coulomb potential as well as double scattering are treated exactly. The conventional electromagnetic current operator for point protons with charge and magnetic moment is used. Cross sections differential with respect to the photon angle are calculated in the symmetric, coplanar Harvard geometry for proton angles of 10, 20, and 30°, at laboratory energies of 5, 20, 42, 62, 99, and 158 MeV, using the Hamada-Johnston potential. Cross sections integrated over the photon angle are presented over a wider range of angles. Including the Coulomb potential lowers the cross section by amounts which are comparable with the errors of the most accurate experiments, and at proton angles smaller than any of the existing experiments the Coulomb effect becomes quite large. Cross sections for the asymmetric Orsay experiment are also computed, including the effect of noncoplanarity, and there is a large discrepancy at some of the experimental points. (auth)

28203 DISPERSION INEQUALITIES FOR FORWARD COMPTON SCATTERING. Guiasu, I.; Radescu, E.E. (Institute of Atomic Physics, P. O. Box 35, Bucharest, Romania). Phys. Rev. D 10: No. 1, 357-361 (1 July 1974).

Using the analyticity and crossing properties of the amplitudes in conjunction with the low-energy theorems, dispersion inequalities involving integrals of the forward Compton-scattering differential cross sections for photon polarized parallel and antiparrellel to the proton spin are established. In particular, a set of two coupled inequalities shows that these cross sections in the energy region from zero up to the threshold of photoproducing a single pion are severely restricted by integrals over their values above this threshold. The results obtained are model-independent and optimal with respect to the information taken as known. (auth)

28204 ANALYTIC REPRESENTATION FOR NEUTRON ELECTROPRODUCTION STRUCTURE FUNCTIONS. Shepard, H.K. (Department of Physics, University of New Hampshire, Durham, New Hampshire 03824); Simmons, L.M. Jr. Phys. Rev. D 10: No. 1, 326-329 (1 July 1974).

Expansions in the new variable suggested previously (by consideration of scaling-plane analyticity) are obtained for the deep-inelastic structure functions ($\nu W_2{}^p - \nu W_2{}^n$) and $\nu W_2{}^n$. The resulting minimum-χ^2 fits to the MIT-SLAC data favor an $F_2{}^n$ which monotonically decreases at large ω. (auth)

28205 POLARIZED ELECTROPRODUCTION AS A TEST OF PARTON MODELS WITH STRUCTURE. Colglazier, E.W.; Rajaraman, R. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 10: No. 1, 334-337 (1 July 1974).

As shown by West, a parton model in which the quark has a small size and anomalous magnetic moment can accommodate the large scaling violation of e^+e^- annihilation into hadrons with the approximate scaling of νW_2 in electroproduction. We point out that a sensitive test of the model is provided by certain structure functions in polarized electroproduction which are predicted to have nearly an order of magnitude larger deviation from scaling than W_1, σ_L/σ_T, or σ ($e^+e^- \to$ hadrons) at the same q^2. (auth)

28206 ELECTROPRODUCTION OF POLARIZED HADRONS WITH POLARIZED BEAMS AND TARGETS. Actor, A. (Institut für Theoretische Physik der Universität Heidelberg). Ann. Phys. (N.Y.) 84: No. 1, 318-334 (15 May 1974).

Formulas of a general and explicit nature are obtained for electroproduction of any polarized hadron state from a polarized target with a polarized beam. The one-photon exchange approximation is used and the final formulas are given in terms of virtual photon helicities. Formulas are derived for cross sections and for final state spin density matrix elements. The latter enable one to construct any final state polarization parameter or to write out any final state decay

distribution with minimal effort. Exclusive and semiinclusive reactions are discussed on an equal basis. All particle spins are assumed to be polarized. Specialization is made to any case of experimental interest by summing over unwanted spin indices. It is hoped that such a general formulation of electroproduction kinematics will be of use in the planning of experiments with polarized beams and targets. (auth)

28207 GAUSSIAN DISTRIBUTIONS IN ELECTROPRODUCTION AND INCLUSIVE e^+e^- ANNIHILATION. Orfanidis, S.J.; Rittenberg, V. (Rockefeller University, New York, New York 10021). Phys. Rev. Lett. 33: No. 7, 455-458 (12 Aug 1974).

In a large class of theories, including asymptotically free theories, and theories with an eigenvalue for the coupling constant, it is shown that under an important uniformity assumption, the electroproduction and inclusive annihilation structure functions should, for large Q^2, be Gaussian in the variable $y=\ln\omega$. The average and width of the distribution are increasing functions of Q^2. This result is compared with preliminary data from SPEAR on the one-particle inclusive distributions. (auth)

28208 IS THE CROSS SECTION FOR $e^+e^- \to$ HADRONS TIME DEPENDENT IN COLLIDING BEAM MACHINES?. Goldman, T.; Vinciarelli, P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 33: No. 4, 246-250 (22 July 1974).

If $e^+ + e^- \to \Phi \to$ hadrons, where Φ is a scalar, radiative beam polarization in storage rings will induce an apparent time dependence of the cross section during an experimental run. This should provide a critical test for models which rely on such a scalar mechanism to enhance the cross section in the present energy range. A model of this kind is presented which identifies Φ with a composite Higgs field in gauge theories. We check for consistency with other processes and note that there may be an important relation to the shoulder in the dimuon mass distribution in $pp \to \mu^+\mu^- X$. (auth)

28209 PROCEEDINGS OF THE 6th INTERNATIONAL SYMPOSIUM ON ELECTRON AND PHOTON INTERACTIONS AT HIGH ENERGIES, BONN, GERMANY, AUGUST 27-31, 1973. Rollnik, H.; Pfeil, W. (eds.). New York; American Elsevier Publishing Company, Inc. (1974). 586p. (CONF-730842-).

Twenty-one papers are included; a separate abstract is prepared for each paper. (LBS)

For abstracts of individual papers see: 28140-28146, 28153, 28210-28219, 28247, 28248, and 28617.

28210 THEORIST'S VIEW OF e^+-e^- ANNIHILATION. Bjorken, J. D. (Stanford Univ., CA). pp 26-47 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

The discussion on e^+e^- annihilation includes the following subjects: total cross-section behavior; weak-interaction effects; exclusive channels; two-photon processes; and multihadron final states. (LBS)

28211 THEORETICAL ASPECTS OF PHOTO- AND ELECTROPRODUCTION IN THE RESONANCE REGION. Von Gehlen, G. (Univ., Bonn). pp 116-143 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

Some kinematical considerations about the interdependence of different measurable quantities are first discussed. Other topics discussed are pion photoproduction analysis of the $\Delta(1232)$ region; multipole analysis of the higher resonance regions; further theoretical work on resonance pion photoproduction; photoproduction and quark models; multiple pion photoproduction; eta and kaon photoproduction; sum rules, zeroes, relation to Compton scattering; threshold photo- and electroproduction; and resonance electroproduction. (LBS)

28212 TWO-BODY AND QUASI-TWO-BODY PRODUCTION OF PSEUDOSCALAR AND VECTOR MESONS. Talman, R. (Cornell Univ., Ithaca, NY). pp 146-174 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

Exclusive production of pseudoscalar and vector mesons is reported with emphasis on electroproduction. The topics discussed include: total virtual cross sections; formalism; low-t production of pseudoscalar mesons; pseudoscalar mesons at high t; electroproduction of rho's; other vector meson; and measurement of the η^0-lifetime using the Primakoff effect. (LBS)

28213 HIGH-ENERGY TWO-BODY PHOTOPRODUCTION. Salin, P. (CERN, Geneva). pp 201-226 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

High-energy two-body photoproduction reactions are reviewed from a phenomenological standpoint. Vector meson photoproduction is examined as a tool to investigate properties of diffractive reactions. The occurrence of a possible $J = 0$ fixed pole in the Compton amplitude is then studied. Finally, pseudoscalar meson photoproduction is discussed with some comments of new experimental facts and a brief survey of the present theoretical investigations. (LBS)

28214 RECENT RESULTS CONCERNING THE ELECTROMAGNETIC STRUCTURE OF THE NUCLEON. Bloom, E. D. (California Inst. of Tech., Pasadena). pp 227-250 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

Experimental evidence which exists for and against the parton and the light cone ideas is discussed. In particular, the following statements which are testable in electroproduction and seem to be firm predictions of light cone and parton theories are examined: a) νW_2 must scale; b) $4 > \nu\, W_2^p/\nu\, W_2^n > 0.25$; and c) $R = r(\omega)/\nu$, where ω is a scaling variable. Finally, tests of substructure from neutrino experiments are discussed. (LBS)

28215 PARTICLE PRODUCTION. Brasse, F. W. (DESY, Hamburg). pp 251-283 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

A review is given of measurements of particle distributions, multiplicity of charged particles, and topological cross sections in inclusive photoproduction and electroproduction. Results are summarized for π^+ and π^- photoproduction, π^+/π^- ratio, π^0 production, proton and neutron distributions, and K^+, K^- production. (LBS)

28216 THEORY OF INCLUSIVE PROCESSES. Rubinstein, H. R. (Weizmann Inst. of Science, Rehovot, Israel). pp 285-298 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

The following topics are discussed: duality, deep inelastic scattering in a model with constituent and current quarks, parton model, and scaling and scaling breaking. (LBS)

28217 WEAK AND ELECTROMAGNETIC FORM FACTORS OF HADRONS. Gourdin, M. (Univ., Paris). pp 407-427 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

A review is given of the theoretical and experimental information on the π meson electromagnetic form factor and the nucleon axial vector form factor. (LBS)

28218 UNIFIED MODELS OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Smith, C. H. L. (CERN, Geneva). pp 449-465 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

A review is given on the status of attempts to construct renormalizable models of weak and electromagnetic interactions

based on spontaneously broken gauge theories. The basic elements of the models are first outlined; the problems encountered in model building are then discussed. Finally, some brief remarks are given on the implications of recently reported evidence for neutral currents. (LBS)

28219 LIGHT CONE PHYSICS, WHERE DO WE STAND. Preparata, G. (Univ., Rome). pp 468-492 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

An attempt is made to evaluate the importance of the ideas which form the nucleus of light cone physics, to understand their limitations, and to analyze possible ways to overcome the difficulties in light cone physics. Some consequences of the light cone approach are discussed for deep-inelastic electron-nucleon scattering, massive μ pairs production in pp collisions, e^+e^- physics, and the divergence problem in electromagnetic and weak interactions. (LBS)

28220 CLASSICAL ELECTRODYNAMICS. The Equation of Motion. Hogan, P. A. (Dublin Inst. for Advanced Studies). Proc. Cambridge Phil. Soc.; 76: No. 1, 359-367(Jul 1974).

A derivation is given for the Lorentz-Dirac equation of motion for a charged particle moving in an external electromagnetic field. Maxwell's electromagnetic field equations are used together with the assumptions that all fields are retarded and that the 4-force acting on the charged particle is a Lorentz 4-force. To define the self-field on the world-line of the charge, a contour integral representation for the field due to A. W. Conway is used. This by-passes the need to define an "average field." The case of a scalar field is briefly discussed. (auth)

28221 MULTIPLE GENERATION OF PIONS IN COLLIDING ELECTRON–POSITRON BEAMS. Dal'karov, O. D.; Khoze, V. A.; Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 8, 282-283 (20 Apr 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 8, 534-538(20 Apr 1974).

It is shown that the experimentally observed p' meson is a quasinuclear $^3S_1$ state of the $N\bar{N}$ system. The existence of one more relatively narrow resonant maximum ($\Gamma \lesssim 10$ MeV) in multiple generation of an even number of pions is predicted, with an energy close to two nucleon masses. (auth)

28222 EXISTENCE OF MAGNETIC MONOPOLES. Parkash, O.; Rajput, B. S. (Kurukshetra Univ., India). Indian J. Phys.; 48: No. 2, 152-160(Feb 1974).

Reduction of generalized electromagnetic fields to the irreducible representations of proper, orthochronous, inhomogeneous Lorentz group was carried out, and it was shown that for these fields to satisfy generalized field equations, the electric and magnetic charge and current source densities are proportional to the corresponding fundamental charges. Considering generalized charge as a complex quantity, the real and imaginary parts of which are electric and magnetic charges, the values of electric and magnetic parameters were derived, and it is shown that the zero in the charge quantization condition is forbidden for every particle of the system to bear both the charges. It was also proved that first allowed value in the charge quantization condition is unity. (auth)

28223 BEHAVIOR OF CHARGED PARTICLE DISTRIBUTIONS IN TIME-INDEPENDENT STOCHASTIC MAGNETIC FIELDS. Kaiser, T. B. College Park, MD; Univ. of Maryland (1973). 151p. University Microfilms Order No. 74-17,045.

Thesis (Ph. D.).

The evolution in time of a distribution of charged particles in a static magnetic field which possesses an appreciable random component is considered. Such a field provides a model that is compatible with observations of the magnetic field in the solar wind. Quasilinear theory, which is the lowest-order nontrivial approximation to the general perturbation scheme commonly used to derive a kinetic equation for the pitch-angle distribution function, is shown to breakdown for pitch angles near $\pi/2$. This failure is due to the incorrect description of particle orbits at such pitch angles that is inherent in the standard perturbation method. A new perturbation formalism is proposed which is based on an improved representation of particle trajectories that includes the essential effect of the random component of the field. The new approach is used to derive a diffusion equation for the pitch-angle distribution function which is a generalization of the quasilinear diffusion equation that is valid for all pitch angles. In the new theory the sharply resonant interaction between a particle and a particular static wave mode is broadened for pitch angles near $\pi/2$ by the effect of the random field, in a manner similar to the resonance broadening that occurs in the theory of electrostatic plasma turbulence. As a result, the diffusion coefficient at $\mu \equiv \cos\theta = 0$ (θ is the pitch angle) is finite and nonvanishing, regardless of the particular form of the power spectrum of the random magnetic field. This is in sharp contrast to the case in quasilinear theory, where the diffusion coefficient vanishes at $\mu = 0$ for all physically realizable power spectra. The special case of a magnetic field with a power spectrum of the form, $P(k) \sim k^{-2}$, is considered in detail. The pitch-angle diffusion coefficient is evaluated explicitly and compared with the corresponding quasilinear expression. The two are found to agree for $\delta B_{rms}/\langle B\rangle \ll |\mu| \leq 1$, and disagree for $0 \leq |\mu| \lesssim \delta B_{rms}/\langle B\rangle$, where δB_{rms} is the rms random field strength and $\langle B\rangle$ is the strength of the average field. A computer simulation of the behavior of charged particles in such a field is performed, and the results compared with theory. It is found that: particles diffuse through $\mu = 0$ at an appreciable rate, contrary to the prediction of quasilinear theory; the simulation data are successfully explained by the new theory in that range of pitch angles for which quasi-linear theory is inadequate. It is concluded that the evolution of the pitch-angle distribution in a random magnetic field is quite generally diffusive in nature, and well described by the new theory. (Diss. Abstr. Int., B)

28224 ESTIMATES OF THE EIGHTH-ORDER CORRECTIONS TO THE ANOMALOUS MAGNETIC MOMENT OF THE MUON. Samuel, M. A. (Stanford Univ., CA). Phys. Rev., D; 9: No. 10, 2913-2919(15 May 1974).

All the diagrams which contribute to the eighth-order muon anomaly are classified and their contributions are estimated. The Kinoshita method is used whenever possible. The total correction is estimated to be $230(\alpha/\pi)^4 = 6.7 \times 10^{-9}$. (auth)

28225 INCLUSIVE ELECTROPRODUCTION IN THE PHOTON FRAGMENTATION REGION. Lam, W. S.; Tran Thanh Van, J.; Uschersohn, I. (Science Research Council, Chilton (UK). Rutherford Lab.). Nucl. Phys., B; 74: No. 1, 59-67(18 May 1974).

The Regge-Mueller description is applied to the inclusive electro-production of positive and negative pions with proton and neutron targets. It is shown that in the photon fragmentation region if there is an excess of positive pion production over the negative pion production with a proton target, then there is also an excess of positive pion production over the negative pion production with neutron target. Predictions of the x-distributions of the inclusive cross sections with the neutron target calculated from the proton target data are in good agreement with the experimental results. Following the argument in duality, the data are also analysed using the triple-Regge formula. It is found that the contribution of the pion pole is important even at large value of q^2. (auth)

28226 QUASI THREE BODY E^+E^- ANNIHILATION. Hirshfeld, A. C.; Kramer, G. (Hamburg Univ. (F. R. Germany). 2. Inst. fuer Theoretische Physik). Nucl. Phys., B; 74: No. 2, 211-236 (25 May 1974).

The helicity formalism for e^+e^- annihilation into three-body and quasi-three-body final states is presented. Expressions for the cross sections and angular distributions are derived in the one-photon-exchange approximation. For the process $e^+e^- \to \rho\pi\pi$ the results of calculations based on various low-lying exchanges and VMD assumptions for the form factors are exhibited. When two of the final state particles resonate, the formalism allows the reliability of the narrow-width approximation made in previous work to be studied, and certain interference effects previously neglected to be included. (auth)

28227 DEEP INELASTIC LEPTON-NUCLEON INTERACTIONS AND THE STRUCTURE OF THE NUCLEON: STRUCTURE FUNCTIONS, MULTIPLICITIES AND ν, ANTI ν TOTAL CROSS SECTIONS. Wang, C. P. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science); Lin, A. L. L. (Catholic Univ. of America, Washington, D. C. (USA). Dept. of Physics). Nucl. Phys., B; 74: No. 2, 298-320(25 May 1974).

Structure functions for νN and $\bar{\nu}$N interactions were obtained from the three-quark-boson nucleon model constructed before from the study of deep inelastic eN scattering. The results obtained give quantitative relations between eN and νN, $\bar{\nu}$N interactions, and explicit expressions for the differential and integral cross sections, $d\sigma^{(\nu,\bar{\nu})}/dx$, $d\sigma^{(\nu,\bar{\nu})}/dy$ and $\sigma^{(\nu,\bar{\nu})}$. With the energy dependence of pion multiplicity for νN interactions deduced from the experimental data, the calculated total νN cross sections with no free parameters reproduce both the CERN 1967 propane and the recent Gargamelle results. For $\bar{\nu}$N interactions, the calculated total cross sections agree also with the Gargamelle data, giving the ratio $\sigma_{tot}^{(\bar{\nu})}/\sigma_{tot}^{(\nu)} \approx 0.38$ at CERN energies, and a

lower pion multiplicity (i.e., about one-half the νN multiplicity) is predicted. Excluding the effects of intermediate bosons, all the four $\sigma^{\nu p}$, $^{\nu n}$, $^{\bar{\nu} p}$, $^{\bar{\nu} n}$ have the same "asymptotic" cross section $\sigma_\infty = \frac{2}{3} G^2 ME/\pi$, although the approach to this limit is extremely slow except for $\sigma^{\nu p}$. (auth)

28228 THE EQUIVALENT POLARISED-PHOTON APPROXIMATION. Brown, C. J.; Lyth, D. H. (Lancaster Univ. (UK)). Nucl. Phys., B; 73: No. 3, 417-428(11 May 1974).

The equivalent photon approximation is studied for the case where the scattered electron is detected. The equivalent photon is then polarised. The region of validity is found to depend on the virtual photon scattering angle, rather than on the electron scattering angle, and this distinction is important. A discrepancy concerning the dependence on beam energy of the total cross section for $e\bar{e} \rightarrow e\bar{e}$ + hadrons which was noted by Bonneau et al. is resolved. (auth)

28229 ELECTROPRODUCTION FINAL STATES AS $\omega \rightarrow 1$. Close, F. E. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 73: No. 3, 410-416 (11 May 1974).

The successful model of Barbour and Moorhouse for pion photoproduction is extended to electroproduction and combined with recent ideas on configuration mixing or SU(6) breaking in deep inelastic electroproduction as $\omega \rightarrow 1$. It is found that two consequences obtain in the current fragmentation region as $\omega \rightarrow 1$; (a) the missing mass spectrum in $ep \rightarrow e\pi^- X$ and $en \rightarrow e\pi^+ X$ will be featureless (phase space); (b) in $ep \rightarrow eM^{+,0} X$ and $en \rightarrow eM^{0,-} X$ for any non-strange meson M the missing hadron system will contain only octets. Hence, in particular, $ep \rightarrow e\pi\Delta$ will vanish relative to $ep \rightarrow e\pi^+ n$ as $\omega \rightarrow 1$. For K production only Λ and no Σ final states will be produced. (auth)

28230 A CALCULATION OF PHOTON DECAY. Parkinson, M. (Florida Univ., Gainesville (USA). Dept. of Physics and Astronomy). Nucl. Phys., B; 74: No. 2, 269-284(25 May 1974).

A calculation of the decay of the photon to lowest order in the gravitational coupling constant is presented. The decay is highly non-exponential, and in addition is characterized by a finite asymptotic survival probability. The results are sensitive to the choice of the photon form factor. Depending on how it behaves, one gets: (a) no visible effects (b) the possibility of performing the gravito-electric effect (c) astronomical intensity-frequency correlations, or (d) some combination of the above. (auth)

28231 HEAVY FERMIONS AND PROTON-NEUTRON MASS DIFFERENCE. Frenkel, J.; Frenkel, M. L.; Ebel, M. E. (Wisconsin Univ., Madison (USA). Dept. of Physics). Nucl. Phys., B; 74: No. 1, 125-144(18 May 1974).

A class of gauge theories containing heavy fermions is discussed. It is shown that heavy baryons can be relevant to the mass splitting within isotopic multiplets. In particular, it is suggested that they may play an important role in obtaining the correct result for the proton-neutron mass difference. The role of heavy fermions in achieving the β and μ decay universality is stressed. (auth)

28232 DEEP INELASTIC TWO-PARTICLE DISTRIBUTIONS IN THE TWO-COMPONENT PARTON MODEL. Chaichian, M.; Kitakado, S.; Lam, W. S.; Zarmi, Y. (Bielefeld Univ. (F. R. Germany)). Nucl. Phys., B; 74: No. 1, 111-124(18 May 1974).

The two-component parton model is used for the description of inclusive two-particle distributions in the deep inelastic region. Simple predictions for the cross sections and correlation functions in electroproduction and in e^+e^- annihilation are presented. (auth)

28233 RADIATIVE DECAY OF AN EXCITED NEUTRINO IN GAUGE MODELS. Bertlmann, R.; Grosse, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik); Lautrup, B. (Institut des Hautes Etudes Scientifiques, 91-Bures-sur-Yvette (France)). Nucl. Phys., B; 73: No. 3, 523-535(11 May 1974).

The decay of a heavy neutral lepton into a neutrino and a photon is studied. In theories with a charged intermediate vector boson the decay rate is finite (in the one-loop approximation), provided the anomalous magnetic moment of the vector boson is exactly one, as it is in unified gauge models of weak and electromagnetic interactions. The results exhibit strong model dependence. (auth)

28234 ON THE SLOPE OF THE DIFFERENTIAL CROSS SECTION FOR THE PHOTO- AND ELECTROPRODUCTION OF VECTOR MESONS. Snell, V. (Cambridge Univ. (UK)). Nucl. Phys., B; 73: No. 3, 497-508(11 May 1974).

The photo- and electroproduction of ρ mesons at high energy is examined in a simple Regge-pole model with q^2 dependent residues. The behaviour of the differential cross section at $t = 0$ and of its slope, as a function of q^2 and of the photon energy, is correlated, and good fits to the data are obtained. (auth)

28235 ON THE VACUUM CORRECTIONS TO THE CLASSICAL SYNCHROTRON RADIATION. Skobelev, V. V. (Moskovskij Gosudarstvennyj Univ. (USSR). Fizicheskij Fakul'tet). Phys. Lett., A; 48: No. 3, 229-230(17 Jun 1974).

A general expression for the vacuum radiation of a moving point charge is applied to the case of movement along circumference. It implies the vacuum polarization corrections to the classical synchrotron radiation, which can be observed experimentally at high energies. (auth)

28236 THRESHOLD ELECTROPRODUCTION EXPERIMENTS AND THE AXIAL VECTOR FORM FACTOR. Read, B. J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nucl. Phys., B; 74: No. 3, 482-492(4 Jun 1974).

Data from three coincidence experiments which measure the cross section for π^+ electroproduction around threshold are compared. Application of the PCAC motivated pseudovector Born approximation model yields corresponding values of the nucleon axial vector form factor for spacelike momentum transfer up to 0.6 GeV^2. Attention is paid to possible theoretical uncertainties and to the influence of the first pion-nucleon resonance. (Recent single arm SLAC results are also included.) (auth)

28237 CORRESPONDENCE ARGUMENTS FOR LARGE ANGLE SCATTERING. Scott, D. M. (Cambridge Univ. (UK)). Nucl. Phys., B; 74: No. 3, 524-540(4 Jun 1974).

The correspondence principle of Bjorken and Kogut is used to relate inclusive and exclusive processes at large angle. Each inclusive cross section of a certain type is shown to lead to a definite result for an exclusive cross section. A study of models suggests that diagrams exhibiting leading particle structure are important at least near the edge of phase space. pp, πp and γp scattering are discussed using such diagrams, and correspondence enables tests of dimensional counting arguments for large angle hadron-parton exclusive amplitudes to be made. (auth)

28238 ON THE RATIO Σ^0/Λ IN ELECTROPRODUCTION OFF PROTONS. Nachtmann, O. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). Nucl. Phys., B; 74: No. 3, 422-428(4 Jun 1974).

Recent experimental results on electroproduction off protons show that the ratio $\sigma(ep \rightarrow eK^+\Sigma^0)/\sigma(ep \rightarrow eK^+\Lambda)$ decreases strongly with increasing Q^2. A simple argument is given in the framework of the quark parton model which could provide a qualitative understanding of this fact. The decrease of the Σ^0/Λ ratio is related to the decrease of the ratio $F_1^{\gamma n}/F_1^{\gamma p}$ as Q^2 increases, where $F_1^{\gamma p}$ and $F_1^{\gamma n}$ are the usual structure functions for deep inelastic electron-nucleon scattering. (auth)

28239 IS α′ ALSO THE e^{+-} ANNIHILATION SCALE. Ferro Fontan, C.; Rubinstein, H. R. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 74: No. 3, 378-386(4 Jun 1974).

A model for the annihilation of electron-positron pairs into hadrons for $q^2 = s > 4$ GeV^2 and up to the highest measured energies is developed. The main ingredients are pointlike couplings between three resonances and photons and the high level of opening thresholds that follows from an effective Lagrangian formalism. The model gives an almost constant annihilation cross section, soft pions everywhere and at all energies, high multiplicities and a large absolute cross section. The details of all exclusive channels are also predicted. Other consequences of this point of view concern the discovery of hitherto ignored couplings in low-energy photon initiated reactions. It is argued that the energy regime explored by SPEAR is not the asymptopia and possible further constancy of the cross section in a range of s is discussed. (auth)

Weak

Refer also to abstracts 28153 and 28312.

28240 (JINR-P2-7985) SOME PHYSICAL CONSEQUENCES IN THE NONPOLYNOMIAL MODEL OF WEAK INTERACTIONS. Abdullaev, F. Kh.; Yumatov, A. Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 25p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

Some physical consequences in the nonpolynomial model of weak interactions are considered. The existence of universal essentially nonlinear coupling between hadrons and the scalar mesons is assumed (the variant of scalar mesons dominance model). With the help of Lagrangians the amplitude for $K_L^0 \rightarrow \bar{\mu}\mu$ decay is calculated using the technique of superpropagators. The result is compared with that given by the nonrelativistic quark model for composite mesons. The contribution of virtual weak corrections in the second order on G_F is small. The $K_L^0 \rightarrow K_S^0$ mass difference is also

calculated. The $K^+ \to \pi\nu\bar{\nu}$, $\Lambda \to ne^+e^-$ probabilities are predicted, if one takes into account the value of ϵ which follows from the investigation $K_L^0 \to \bar{\mu}\mu$ decay and $K_L^0 - K_S^0$ transition. (auth)

28241 QUARK–PARTON MODEL WITH PAIR CORRELATION. Bajpai, R.P.; Mukherjee, S. (Department of Physics, Centre for Post–Graduate Studies, Himachal Pradesh University, Simla–171001, India). Phys. Rev. D 10: No. 1, 290-297 (1 July 1974).

A relativistic quark–parton model is used to study the deep–inelastic lepton–hadron scattering phenomena. It is assumed that there is some correlation among the valence quarks, at least near the threshold of the deep–inelastic region. The assumption has been motivated by the observed threshold behavior of the structure functions of the nucleon. The inclusion of the pair correlation leads to an improved agreement between the quark–parton results and the experimental data. The question of the validity of the model has also been studied. (auth)

28242 LIGHT–CONE ALGEBRA AND THE STRUCTURE OF WEAK NEUTRAL CURRENT. Razmi, M.S.K. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). Phys. Rev. D 10: No. 1, 362-365 (1 July 1974).

Light–cone algebra of Fritzsch and Gell–Mann is used to suggest tests for the structure of recently discovered weak neutral current. (auth)

28243 PARITY VIOLATION IN DEEP–INELASTIC CHARGED LEPTON–HADRON SCATTERING. Wilson, W.J. (Jefferson Physical Laboratory, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 10: No. 1, 218-222 (1 July 1974).

The possibility of detecting parity violation in deep–inelastic charged lepton–hadron scattering using polarized lepton beams is discussed. Assuming scaling, the quark–parton picture of the nucleon, and some general features of the weak currents, a general formula for the size of the parity–violating effect is derived. Specific estimates are made for various spontaneously broken gauge–symmetry models of the weak and electromagnetic interactions. (auth)

28244 NONLEPTONIC DECAY AND THE CURRENT × CURRENT THEORY. Pakvasa, S. (Univ. of Hawaii, Honolulu); Rosen, S.P. pp 437-480 of Past Decade in Particle Theory. Sudarshan, E.C.G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

Current–x current theory for the study of the paradoxical behavior of nonleptonic decay in terms of strangeness and parity nonconservation is treated. For this purpose the complex structure of the current algebra theory of nonleptonic decay is studied, and the consequences of each element in it examined separating the predictions of one element from those of another. Various meson and baryon decays are considered. (JFP)

28245 EXPERIMENTAL VERIFICATION OF WEAK INTERACTIONS AND THE MUON PUZZLE. Telegdi, V. (Univ. of Chicago). pp 481-517 of Past Decade in Particle Theory. Sudarshan, E.C.G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

Various muon properties are described. It is noted that the muon puzzle still exists. (JFP)

28246 WEAK INTERACTIONS. Nilsson, J. (Inst. of Theoretical Physics, Goteborg). pp 637-717 of Past Decade in Particle Theory. Sudarshan, E.C.G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

The developments during the past decade in weak interaction theory are reviewed. A brief outline is also given of some of the major contributions made prior to 1960. The current × current theory of weak interactions, the empirical status of the empirical selection rules, the Cabibbo model for the hadron current, current algebra of SU(3) × SU(3), conserved current hypothesis and the partial conservation of the axial vector current, low energy theorems and current algebra, and some open questions are covered. (JFP)

28247 NEUTRAL CURRENTS. Myatt, G. (Oxford Univ.). pp 389-406 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

In the first part of the review the new experimental results concerning neutral currents which have become available since the Batavia-Chicago Conference 1922 are briefly discussed. The latter part of the review is devoted to a general review of all data on leptonic and semileptonic neutral currents in neutrino interactions in the context of the Weinberg-Salam unified gauge theory of weak and electromagnetic interactions. (LBS)

28248 KNOWN AND UNKNOWN REGIONS IN LEPTON PHYSICS. Drell, S. D. (Stanford Univ., CA). pp 493-511 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

The progress made in the last decade in lepton physics is reviewed. Various issues that remain open are discussed: scaling in electromagnetic processes; elastic form factors, the time-like region, and neutrino processes; and probing neutral currents and PCAC. (LBS)

28249 ANALYSIS OF MASS SHIFT DUE TO WEAK INTERACTIONS. Fayyazuddin (European Organization for Nuclear Research, Geneva (Switzerland)); Riazuddin (Institute of Physics, Islamabad, Pakistan). Nucl. Phys., B; 74: No. 3, 397-421(4 Jun 1974).

Within the framework of light-cone algebra it is shown that there is no logarithmic divergence of order g_W^2 in the mass shift for a hadron due to weak interactions for currents having V-A structure, provided the weak interactions are mediated by vector bosons. As previously shown for electromagnetic mass shift, the source of this divergence is the mass term in the quark propagator. The contribution of this term to light-cone algebra vanishes due to the V + A character of weak currents and this is the reason for absence of divergence of order g_W^2 in the weak mass shift. This result has important implications for unified gauge models for weak interactions based on semi-simple Lie groups of type SU (n) ⊗ U(1) or $SU_L(n) \otimes SU_R(n) \otimes U(1)$. For these models $g_W^2 \otimes \alpha$, and the logarithmic divergence in the mass shift of a hadron can only arise from the current associated with U(1). For a mass difference of order α between an isospin multiplet to be finite and computable, U(1) must be associated with an isoscalar quantity. (auth)

28250 PARTON MODEL EXPECTATIONS FOR WEAK PION PRODUCTION BY NEUTRAL CURRENTS. Cleymans, J. (European Organization for Nuclear Research, Geneva (Switzerland)); Sehgal, L. M. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.). Nucl. Phys., B; 74: No. 2, 285-297(25 May 1974).

A quark model for the Weinberg-Salam theory is used in conjunction with the parton fragmentation hypothesis of Feynman to obtain the distribution of a final state hadron H produced in semi-inclusive neutrino reactions. A general relation is obtained between the neutral to charge current ratios $R(H) = \sigma(\nu \to \nu + H)/\sigma(\nu \to \mu^- + H)$ and $\bar{R}(H) = \sigma(\bar{\nu} \to \bar{\nu} + H)/\sigma(\bar{\nu} \to \mu^+ + H)$ which is sensitive to the value of the parameter $\sin^2\theta$. Particular relations are derived among the ratios $R(\pi)$ and $\bar{R}(\pi)$. All predictions refer to the parton fragmentation region of phase space. (auth)

Strong (General)

Refer also to abstracts 28309, 28319, 28320, and 28539.

28251 (COO-2009-68) BRIEF REPORT ON RESEARCH PERFORMED UNDER THE THEORETICAL PARTICLE PHYSICS RESEARCH PROGRAM. Chu, S. Y.; Hendry, A. W.; Lichtenberg, D. B. (Indiana Univ. of Pennsylvania (USA). Dept. of Physics). Dec 1973. Contract AT(11-1)-2009. 7p. Dep. NTIS $4.00.

Theoretical research on strong interactions is summarized. (JFP)

28252 A STUDY OF THE HILBERT SPACE PROPERTIES OF THE VENEZIANO MODEL OPERATOR FORMALISM. Brink, L.; Frampton, P.H.; Nielsen, H.B. (CERN, Geneva, Switzerland). J. Math. Phys. (N.Y.) 15: No. 9, 1599-1605 (Sept 1974).

The domains of definition of the operators used to factorize the generalized Veneziano model are studied within the Hilbert space defined by the harmonic oscillator creation and annihilation operators $a_\mu^{(r)\dagger}$, $a_\mu^{(r)}$. These individual operators may not be well behaved, although, of course, the matrix elements used in the conventional operational factorization are well defined. Concerning the individual operators, it is shown that the ground–state vertex written as $V(p) = \exp[-\sum_{r=1}^{\infty} (p\cdot a^{(r)\dagger})/\sqrt{r}]\exp[\sum_{r=1}^{\infty} (p\cdot a^{(r)})/\sqrt{r}]$ is nowhere defined within the Hilbert space; the product with a twisting operator Ω (q)V(p) is, however, densely defined, as is the symmetrical three–reggeon vertex. The

propagator D(p) is bounded everywhere, away from its poles. The twisting operator Ω (p) is undefined on finite occupation states, but is densely defined on a subset of coherent states; its Hermitian conjugate Ω^+(p) is densely defined on both finite occupation and coherent states. It is found that a suitable rewritten form of the product D(q)V(p) is densely defined for certain values of momenta; this relates to the fact that off-mass shell states satisfying $(L_0-L_{-r}-1)|\Phi>=0$, where L_n are the conventional gauge operators, are better defined than those satisfying $(L_0-L_{-r}+r-1|\Phi>=0$. (auth)

28253 EFFECT OF BOSE-EINSTEIN STATISTICS ON MULTIPLICITY DISTRIBUTIONS AND CORRELATIONS IN MULTIPARTICLE PRODUCTION PROCESSES AT HIGH ENERGIES. Knox, W.J. (Department of Physics, University of California, Davis, California 95616). Phys. Rev. D 10: No. 1, 65-72 (1 July 1974).

It is shown that only a small number of elementary cells in phase space is populated in a multiparticle production reaction even at high energy (>100 GeV), leading to occupancy numbers for identical bosons in individual cells which are not small. It follows that quantum-statistical fluctuations are of significant magnitude. The effects on multiplicity distributions and integral correlation functions of π mesons produced in high-energy interactions are derived. Comparison with experimental results at incident energies above 100 GeV indicates that Bose-Einstein fluctuations may be a principal source of broadening of the multiplicity distribution and of positive short-range correlations among identical particles. The effect is nondynamical and nonkinematical in the usual sense, but is due to identical-particle symmetry, and is the counterpart of the Hanbury-Brown-Twiss effect in the electromagnetic field. (auth)

28254 REGGE TRAJECTORIES AND THE QUARK-GLUON COUPLING CONSTANT. Coon, D.D. (University of Minnesota, Minneapolis, Minnesota 55455 and University of Pittsburgh, Pittsburgh, Pennsylvania 15260); Suura, H. Phys. Rev. D 10: No. 1, 348-350 (1 July 1974).

It is argued that vector gluons interacting with quarks produce logarithmic behavior of Regge trajectories at large momentum transfer in agreement with proton-proton scattering data. It is found that $g^2/4\pi = 14$, where g is the gluonic charge (charm) of the quarks. Some suggestive relations between quark-gluon dynamics, duality, magnetic charge and Jacobi's imaginary transformation are discussed. (auth)

28255 INCLUSION OF RESONANCES IN THE MULTIPERIPHERAL MODEL. Pinsky, S.S. (Department of Physics, Ohio State University, Columbus, Ohio 43210); Snider, D.R.; Thomas, G.H. Phys. Rev. D 10: No. 1, 261-274 (1 July 1974).

A simple generalization of the multiperipheral model (MPM) and the Mueller-Regge model (MRM) is given which has improved phenomenological capabilities by explicitly incorporating resonance phenomena, and still is simple enough to be an important theoretical laboratory. The model is discussed both with and without charge. In addition, the one-channel, two-channel, three-channel, and N-channel cases are explicitly treated. Particular attention is paid to the constraints of charge conservation and positivity in the MRM. The recently proven equivalence between the MRM and MPM is extended to this model, and is used extensively. (auth)

28256 ASYMPTOTIC BEHAVIOR OF NON-ABELIAN GAUGE THEORIES TO TWO-LOOP ORDER. Caswell, W.E. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 33: No. 4, 244-246 (22 July 1974).

We have calculated the value of the Callan-Symanzik β function to order g^5 for non-Abelian gauge theories with fermions. We discuss internal consistency of the calculation, and consider the approach to the asymptotic energy range in such theories. (auth)

28257 SYMMETRIC DISTRIBUTIONS OF FERMI QUARKS IN MESONS. Just, K. (Department of Physics, University of Arizona, Tucson, Arizona 85721). Ann. Phys. (N.Y.) 84: No. 1, 247-260 (15 May 1974).

A bound state of fermions can be described by a totally symmetric distribution S as well as by its Bethe-Salpeter amplitude T. Since it vanishes by spin and statistics in the spacelike region, estimating S is easier than solving the Bethe-Salpeter equation for T. These previous findings are here confirmed by a relativistic model for mesons composed of massless quarks interacting by vector gluons. (auth)

28258 SYMMETRIC DISTRIBUTIONS OF BOUND FERMIONS. Just, K. (Department of Physics, University of Arizona, Tucson, Arizona 85721). Ann. Phys. (N.Y.) 84: No. 1, 232-246 (15 May 1974).

Relativistic models of hadrons composed of the simplest kinds of Fermi quarks will be described in subsequent papers by symmetric wavefunctions S, which vanish when all the relative positions of the constituents are spacelike. These S are highly preferable, not in spite of, but thanks to the usual connection of spin and statistics. The principles of the new models are explained in comparison with other quark and parton models. If needed at all, the Bethe-Salpeter amplitude T of a bound state can be obtained from its symmetric distribution S by a "dispersion" integral. An extension to three constituents will be given later. It is precisely because S vanishes for spacelike internal separations that practical estimates for strongly bound states will more readily employ that symmetric distribution than the time ordered T. Field theory and its description of bound states as well as properties and interactions of hadrons are invoked for completeness and the benefit of specialists. Only elementary notions from such topics, however, are needed for the main conclusion. It says that the simplest Fermi quarks (without any "hidden" quantum number) offer the best explanation for the widely accepted symmetry of their wavefunctions in baryons. The failure to observe quarks and also their oscillator shaped interaction within hadrons will later be connected with the same simplicity and a vanishing mass of "bare" quarks. (auth)

28259 EXACT RESULTS IN THE ANALYTIC S-MATRIX THEORY OF STRONG INTERACTIONS FOR HIGH ENERGIES. Singh, V. (Tata Inst. of Fundamental Research, Bombay). pp 151-170 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

After reviewing the history of the development of upper bounds for the scattering amplitude, recent work on new bounds derived from the usual constraints of unitarity and analyticity are reviewed. This material is an expanded version of a talk presented previously. (auth)

28260 EXPERIMENTAL VERIFICATION OF DISPERSION THEORY AND HIGH ENERGY SCATTERING. Lindenbaum, S. J. (Brookhaven National Lab., Upton, NY). pp 255-293 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

A review of the status of experiments to test forward dispersion relations is presented. After discussing the relevance of these measurements, the apparatus is briefly described. This is followed by a description of exactly how the theory is tested. The Pomeranchuk theorem and the recent total cross section data from Serpukhov are discussed. These results are compared with the extrapolations of data available from experiment. (auth)

28261 PARTONS. Feynman, R. P. (California Inst. of Tech., Pasadena). pp 773-813 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

A treatment is given of partons as a device to understand the behavior of hadrons starting from quantum field theory. It is emphasized that it is the wave functions of fast moving particles rather than partons which might be useful for analyzing strong interactions especially at high energies. (JFP)

28262 A UNIFIED APPROACH TO RESONANCES AND PARTONS: A SURVEY OF THE PROBLEMS AND ACCOMPLISHMENTS. Pavković, M.I. (Courant Institute of Mathematical Sciences, New York University 251 Mercer Street, New York, New York 10012). Ann. Phys. (N.Y.) 85: No. 2, 465-482 (June 1974).

A brief survey of the recently proposed unified approach to resonances and partons is presented. A new result is the formula for the mean value of the mass of the parton, $\bar{m}=(1-ad)M_n$, where a is the average distance between the adjacent hadronic levels, d the radius of the nucleon, and M_n its mass. We also discuss the spacelike states in more detail and give a possible parton model interpretation of this less familiar physical phenomenon. (auth)

28263 THE DIFFRACTIVE COMPONENT OF MULTIHADRON PRODUCTION PROCESSES AT HIGH ENERGIES. Harari, H.; Rabinovici, E. (Department of Nuclear Physics, Weizmann Institute of Science, Rehovoth, Israel). Ann. Phys. (N.Y.) 85: No. 2, 483-513 (June 1974).

Multihadron production at high energies proceeds through two mechanisms: A nondiffractive mechanism of a general multiperipheral nature and a diffractive mechanism. Assuming that the diffractive mechanism is dominated at present energies ($s<3000$ BeV^2) by single diffraction excitation we explore its theoretical and pheonomenological implications. In particular we study the question of the rising total cross section. We show that "high mass diffraction excitation" leads to the formation of a central plateau in the inclusive single pion distribution and that the height of this plateau rises with energy and obeys scaling when normalized by the total cross section. We compute the multiplicity distribution for the diffractive component, and deduce the properties of the average multiplicity, its moments, and the statistical mechanics analogue of the "diffractive" Feynman gas. Two-particle correlations are computed and shown to be of a long range nature. Finally we

outline an "improved" two component model into which some of the detailed features of the diffractive part are incorporated. (auth)

28264 CORRELATIONS, SHORT-RANGE ORDER AND CLUSTERING. Slansky, R. (Yale Univ., New Haven, Conn. (USA). Dept. of Physics). Nucl. Phys., B; 73: No. 3, 477-496(11 May 1974).

Several models are used to investigate the sensitivity of the two-particle rapidity correlations to the behavior of the semi-inclusive cross sections and to the kinematical configurations of individual events. Short-range correlations are shown to be present in many models, including some which do not incorporate the short-range order hypothesis. Explicit examples are computed from an independent cluster emission model. A more direct analysis of kinematical configurations indicates that clustering is present. At NAL energies, the cluster size is approximately one-half the average multiplicity. (auth)

28265 DISPERSION RELATIONS WITH DAMPING FUNCTION. Lomsadze, Yu. M.; Agranovsky, B. A.; Sabad, E. P. (Hadron Theory Department, Institute for Theoretical Physics, Academy of Sciences of the Ukrainian SSR, Uzhgorod). Nucl. Phys., B; 73: No. 3, 536-546(11 May 1974).

Dispersion relations are proposed in a new form containing a certain damping function. They contain no arbitrary parameters (subtraction constants or even field coupling constants) and are highly convenient both for experimental tests at high energies and for the description of strong interactions of particles at low and medium energies. (auth)

28266 STATISTICAL CHAIN DECAY OF FIREBALLS WITH QUANTUM NUMBERS. Csikor, F.; Farkas, I.; Katona, Z.; Montvay, I. (Eotvos Lorand Tudomanyegyetem, Budapest (Hungary)). Nucl. Phys., B; 74: No. 2, 343-364(25 May 1974).

The effects of internal quantum number conservation are considered in the statistical chain decay of fireballs. A simple model containing $I = 1$, $G = -1$, $S = 0$ mesons (ground state and excited pions) and $I = \frac{1}{2}$, $S = 0$ baryons (ground state and excited nucleons) is investigated in detail: inclusive distributions, multiplicity distributions and semi-inclusive distributions are determined. The methods are completely general and can be used in more general models with any set of states. As examples, a model with ρ and π mesons, and nucleons and another one with π and K mesons, and N and Λ baryons are considered. (auth)

28267 POMERON SINGULARITIES IN THE FERMION MESON DUAL MODEL. Brink, L.; Fairlie, D. B. (Durham Univ. (UK)). Nucl. Phys., B; 74: No. 2, 321-342(25 May 1974).

The single loop non-planar fermion loops for external mesons are computed in the model of Neveu-Schwarz-Ramond and Mandelstam, using functional methods for the entire calculation. A cancellation of the leading odd G parity pomeron is found, while the even G parity pomeron survives, when the contributions from fermion loops are included. (auth)

28268 REGGE INTERCEPTS AND UNITARITY IN PLANAR DUAL MODELS. Veneziano, G. (Weizmann Inst. of Science, Rehovoth (Israel)). Nucl. Phys., B; 74: No. 3, 365-377(4 Jun 1974).

It is argued that unitarization of planar dual models should follow an "order of summation" different from the usual one according to powers of the coupling constant. If one sums instead "per topology" i.e. planar diagram first, cylinders next and so on, a new perturbation expansion emerges, similar in structure to the one presently employed in analyzing multiparticle processes at ISR and NAL energies. The simplest object is the bare reggeon identified with the plane. It is an exchange degenerate pole; its intercept has to be renormalized away from the tree approximation value ($\alpha(0) = 1$), hence the dual photon has to acquire a mass already at this stage. At the second stage the bare pomeron is "generated" from non-pomeron exchanges by sewing together two planes to form a cylinder. The bare pomeron turns out to be also a pole and its intercept always greater than the reggeon intercept, is exactly one under the assumptions used recently by Lee and the author. Up to this stage a simple short range correlation picture for multiparticle production holds. Higher order corrections are easily seen to bring diffraction dissociation as well as absorptive corrections into the picture. The results are in contrast with those obtained in the standard perturbative approach in which the reggeon and pomeron intercepts seem to be forced at one and two respectively. Finally, a Higgs mechanism is called for, if one demands consistency of the results with the Neveu-Scherk result of non-renormalization of the dual photon mass. (auth)

Strong (Baryon No. = 0)

28269 WIDE-ANGLE BEHAVIOR OF A DOUBLE-SCATTERING DIAGRAM. Predrag Cvitanović (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 1, 338-340 (1 July 1974).

Landshoff has recently pointed out the in composite models for hadron-hadron wide-angle scattering, processes where the constituents remain close to their mass shells throughout the scattering can dominate the wide angle cross sections. We use a Feynman parametric integral to estimate the phase space for such a process and confirm Landshoff's result. The differential cross section for elastic $\pi-\pi$ scattering at fixed c.m. angle is found to fall off as s^{-5}, rather than as s^{-6}, which is predicted by the dimensional-counting rules. (auth)

28270 CURRENT-ALGEBRA THEOREMS FOR $\pi-\pi$ SCATTERING. Graham, R.H.; Weisman, B. (Department of Physics, University of Toronto, Toronto, Ontario, Canada). Phys. Rev. D 10: No. 1, 315-325 (1 July 1974).

The Adler theorem for $\pi-\pi$ scattering is studied with the pions on the mass shell. A technique for evaluating the correction terms is described and they are estimated, using previous hard-pion results. This evaluation is then used to determine fairly stringent bounds on the S-wave scattering lengths. We find it likely that $0.56 \lesssim (2a_0 - 5a_2)m_\pi \lesssim 0.66$. We also investigate the on-mass-shell sum rules for the σ terms. (auth)

28271 QUASINUCLEAR SYSTEMS OF NUCLEONS AND ANTINUCLEONS. Bogdanova, L.N.; Dalkarov, O.D.; Shapiro, I.S. (Institute for Theoretical and Experimental Physics, Moscow, USSR). Ann. Phys. (N.Y.) 84: No. 1, 261-284 (15 May 1974).

It is shown that there exist "nuclear-like" bound and resonant states in NN system. The obtained spectrum contains on the order of twenty levels, all near threshold states ($M \sim 2m$) having nonzero orbital angular momenta of relative N and $\bar{N}$ motion. The quasilinear meson resonances are distinguished by comparatively large partial width for decay into nucleon and antinucleon. Experimental data on annihilation of slow antiprotons in hydrogen and deuterium are considered from the point of view of quasinuclear model. The analysis performed shows that qualitative features of the predicted spectrum of $N\bar{N}$ states are in good agreement with properties of the meson resonances found in these experiments. (auth)

28272 U(6,6) DUALIZED QUARK MODEL PREDICTIONS FOR LOW ENERGY $\pi\pi$ AND πN SCATTERING. Lebrun, J. P. (CERN, Geneva). Acta Chim. Acad. Sci. Hung.; 36: No. 2, 135-147(1974).

In the context of a U(6,6) dualized quark model discussed recently, the satisfaction of low energy theorems and the resulting predictions for the $\pi\pi$ and πN s-wave scattering lengths are studied. The model is found to lead to results in agreement with the standard analysis of Weinberg for $\pi\pi$ and Tomozawa-Weinberg for πN scattering when the ambiguities associated with daughter levels are suitably treated. In the $\pi\pi$ case, it is found that the "kineton" terms removing parity doubled states on the leading trajectory are responsible for the satisfaction of the Adler condition, thus confirming earlier work; conditions similar to intercept quantization and KSFR relation are seen to appear rather naturally. For πN, the model predicts satisfactorily the $(a_1 - a_3)$ combination; concerning the $(a_1 + 2a_3)$ combination, the Adler condition leads to constraints on the exchanged trajectories. A comparison is also made with earlier U(6,6) Lagrangian treatments based on simple pole exchange with "contact" terms. (auth)

28273 THE DERIVATIVE OF THE $\pi^0\pi^0 \to \pi^0\pi^0$ G-WAVE. Common, A. K. (Kent Univ., Canterbury (UK)); Hodgkinson, D. (California Univ., Berkeley (USA)); Pidcock, M. K. (University Coll., London (UK)). Nucl. Phys., B; 74: No. 3, 429-439(4 Jun 1974).

Constraints on the derivative of the G-wave $a_4(s)$ for $\pi^0\pi^0 \to \pi^0\pi^0$ are investigated using crossing sum rules which follow from quadruply subtracted dispersion relations. In particular it is shown that $da_4(s)/ds \leq 0$ for $4\mu^2 \geq s \geq 1.488\,\mu^2$. (auth)

28274 HIGH TRANSVERSE MOMENTA AND ANTI PP ANNIHILATIONS. Everett, D.; Gregory, P.; Grossmann, P.; Mason, P.; Muirhead, H.; Warren, G. (Liverpool Univ. (UK)); Ekspong, G.; Carlsson, R.; Holmgren, S. O.; Nilsson, S. Nucl. Phys., B; 73: No. 3, 440-448(11 May 1974).

The $\bar{p}p$ annihilation process has a predominantly statistical character even at high energies. This has been recently demonstrated in a study of the average transverse momenta produced in various interactions. A further study of the problem concerning the asymptotic behaviour of the annihilation is presented. (auth)

28275 ELASTIC SCATTERING FROM THE TWO-COMPONENT PICTURE. Henyey, F. S. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Nucl. Phys., B; 73: No. 3, 429-439(11 May 1974).

The momentum transfer dependence of high-energy elastic scattering is discussed in the context of the multiperipheral + diffraction picture. Both a "naive" and an "absorbed" model are considered. Fits are made to the impact parameter depen-

dence of the pp elastic amplitude. It is essential in this picture that the diffractive component be peripheral; in the fits it has a zero at |t| between 0.2 and 0.4. The origin of the small t-break in this picture is discussed, and contrasted with its explanation in similar fits. (auth)

28276 POLES AND ZEROS IN $\pi\pi$ SCATTERING AMPLITUDES. Eguchi, T.; Shimada, T.; Fukugita, M. (Tokyo Univ. (Japan). Dept. of Physics). Nucl. Phys., B; 74: No. 1, 102-110(18 May 1974).

Attention is drawn to the remarkable systematics exhibited in the $\pi\pi$ amplitudes provided by the CERN-Munich data. It is shown that the existence of resonance poles with specific spin and mass values and the behaviors of the amplitude zeros in the Mandelstam plane give strong support to the ideas associated with dual resonance models. It is emphasized that some gauge-like conditions of dual resonance models play an essential role in these considerations. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 28181–28183, 28541, and 28549.

28277 (COO-2009-85) THEORETICAL PARTICLE PHYSICS. Progress Report, December 1, 1973–November 30, 1974. Chu, S. Y.; Hendry, A. W.; Lichtenberg, D. B. (Indiana Univ., Bloomington (USA). Dept. of Physics). 1974. Contract AT(11-1)-2009. 18p. Dep. NTIS $4.00.

The major part of the research activity was on the phenomenological treatment of two-body reactions. The differential cross section and polarization for proton-proton elastic scattering, pion–nucleon elastic scattering, and the reaction $pp \rightarrow \pi^+d$ were calculated. Optical models, Regge pole models in both t- and s-channels, a parton model, and a phase-band method were considered. Also the parametrization of strong-interaction resonances was considered taking into account how threshold effects can shift the masses and widths of resonances from their apparent values. Other topics treated were SU(3)-breaking mass formulas, a bootstrap scheme for particle interactions based on an eigenvalue condition for the fine structure constant in nonabelian gauge theories, and a geometric interpretation of gauge fields in an SU(4) invariant theory of particle interactions. (auth)

28278 ISOLATING THE 3–QUARK COMPONENT OF THE PROTON'S WAVE FUNCTION. Gunion, J.F. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. D 10: No. 1, 242-250 (1 July 1974).

The 3–quark component of the proton's wave function is extracted from deep–inelastic proton and neutron scattering data. We employ theoretical results based upon a theory of the hadronic wave function which is consistent with the interchange theory of fixed–angle and high–transverse–momentum processes. (auth)

28279 DUALITY AND πN CHARGE–EXCHANGE DATA. Devenish, R.C.E. (Deutsches Elektronen–Synchrotron, Hamburg, Germany); Martin, B.R. Phys. Rev. D 10: No. 1, 78-79 (1 July 1974).

A previous analysis of π^-p charge–exchange data, using the two–component duality hypothesis and fixed–t dispersion relations, is updated to include recent polarization measurements and high–statistics differential cross sections. (auth)

28280 DUAL FEATURES OF REGGEON–PARTICLE SCATTERING IN $\pi^-p \rightarrow \pi^-\pi^+n$. Hoyer, P. (Institute for Theoretical Physics, State University of New York, Stony Brook, Long Island, New York 11790); Estabrooks, P.; Martin, A.D. Phys. Rev. D 10: No. 1, 80-89 (1 July 1974).

The production of the ρ and f mesons in the reaction $\pi^-p \rightarrow \pi^-\pi^+n$ is analyzed from the point of view of duality for Reggeon–particle scattering. Semilocal duality is found to be compatible with the data both for the Reggeon–particle total cross sections and for the two–particle final state. The duality features impose a strong constraint on the form of the resonance–production amplitudes. (auth)

28281 CHARGE–EXCHANGE VECTOR–MESON PRODUCTION. Field, R.D.; Sidhu, D.P. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 10: No. 1, 89-112 (1 July 1974).

We present an analysis of the six charge–exchange vector–meson production reactions $\pi^-p \rightarrow \rho^0n$, $\pi^+n \rightarrow \rho^0p$, $\pi^-p \rightarrow \omega^0n$, $\pi^+n \rightarrow \omega^0p$, $Kp \rightarrow \bar{K}^{*0}n$, and $K^+n \rightarrow K^{*0}p$ using a Regge–pole plus absorption models and SU(3). Our aim is to understand what existing data imply about these models and to predict and discuss the behavior of as–yet–unmeasured observables. We discuss in detail the amounts of s–channel helicity–nonflip, –flip, and –double–flip absorption required to fit the data. Such topics as the line–reversal breaking in K^{*0} and K^{*0} production, the status of the ρ wrong-signature nonsense zero in w^0 production, and the nature of A_1 exchange are discussed. The electromagnetic mixing of the ρ^0 and ω^0 meson provides a powerful tool for probing the nature of strong–interaction production amplitudes, and examinations of the effects of ρ^0–w^0 mixing on the $\pi^+\pi^-$ mass spectra and on isospin violations in ω^0 productions are included. We find that some of the new absorption models are capable of explaining many features in ρ^0 and ω^0 production and that one is able to correctly predict [using SU(3)] the observables for K^{*0} and K^{*0} production including the line–reversal breaking. The models have problems in predicting the correct energy dependences of $\rho^H\omega(d\sigma/dt)$ and $\rho^H{}_+(d\sigma/dt)$ for ρ^0 production, and have some difficulties in explaining the recent ρ–ω interference data at 4.0 GeV/c, which show a spike at the ω^0 mass of the observable $\rho_+{}^H(d\sigma/dt\ dm)[\pi^-p \rightarrow (\pi^+\pi^-)n]$. (auth)

28282 RADIATIVE CORRECTIONS FOR THE PROCESSES $\pi^\pm p \rightarrow \pi^\pm\pi^+n$. Chen, B.C.; Cushing, J.T. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. D 10: No. 1, 113-135 (1 July 1974).

We use the technique developed by Yennie and his co–workers to calculate the dominant radiative corrections for the processes $\pi^\pm p \rightarrow \pi^\pm\pi^+n$. This includes the "real" radiative corrections, which affect the magnitude of the observed scattering cross section as well as the interference phase between the purely strong amplitude and the electromagnetic one. We also discuss the implications these radiative corrections have for the usual Chew–Low extrapolation scheme which is often used to obtain the $\pi\pi$ elastic scattering cross section from $\pi N \rightarrow \pi\pi N$ production data. (auth)

28283 THE VECTOR AND TENSOR EXCHANGE CONTRIBUTIONS TO $\pi N \rightarrow \pi N$. Argyres, E.N. (State University College of Arts and Science, Plattsburgh, New York 12901); Contogouris, A.P.; Ray, S.; Svec, M. Ann. Phys. (N.Y.) 85: No. 1, 283-300 (30 May 1974).

Using fixed–t dispersion relations together with experimental data on $\pi^-p \rightarrow \pi^0n$, we determine the real and imaginary parts of the s–channel helicity amplitudes (SHA) of the vector (ρ) exchange contribution to $\pi N \rightarrow \pi N$. The results are in good agreement with amplitude analyses. We also make comparison with finite–energy sum–rules (FESR) and discuss certain implications. Furthermore, on the basis of two–component duality and FESR we calculate the tensor (f) contribution. The t–structure of the resulting SHA is compared with independent information on hadronic tensor exchanges. (auth)

28284 πN CHARGE EXCHANGE SCATTERING. Pal, B. K. (Imperial Coll. of Science and Tech., London). Acta Phys. Austr.; 38: No. 1, 47-54(Aug 1973).

A phenomenological description of πN CEX scattering is presented. This model which assumes exchange degeneracy and strong absorption is very different from the two existing models that describe strong interactions with reasonable success. It gives a good explanation of new polarization measurements at laboratory momentum of 5 and 8 GeV/c both qualitatively and quantitatively. (auth)

28285 O(3,1) SYMMETRY AND DIP STRUCTURE OF $0^- + \frac{1}{2}^+ \rightarrow 0^- + \frac{1}{2}^+$ BACKWARD SCATTERING PROCESSES. Saleem, M.; Rafique, M.; Mir, K. L. (Punjab Univ., Lahore, India). J. Natur. Sci. Math.; 12: No. 2, 211-219(Oct 1972).

It is shown that dip structure in all the backward $0^- + \frac{1}{2}^+ \rightarrow 0^- + \frac{1}{2}^+$ reactions for which measurements were made, can be explained on the basis of O(3,1) symmetry model. (auth)

28286 ELASTIC COLLISIONS SPIN 0–SPIN $\frac{1}{2}$ AT HIGH ENERGY. Musette, M. Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1974). 141p. (In French).

Thesis.

The principle purpose is to establish a connection between the behavior of the scattering amplitude for large angles and that for the amplitude for small angles. For this, a model is given for multiple scattering in which one interprets large angle scattering as the result of a succession of elementary collisions, one of these taking place at an angle near 180° and all the others having a small angle. The model with dominant pole exchange in the u channel is used for the description of the elementary collision at large angles, whereas for the calculation of multiple scattering corrections at small angles, with which are associated cuts in the J plane, one uses the results of a Regge pole analyses carried by Barger and Phillips. (This analysis constitutes the most precise phenomenological determination attained to date for the behavior of πN amplitudes at small angles.) The study of elastic scattering theory is redone by Regge poles for the πN and KN collisions at high energies, and certain aspects of the formalism are specified which are not expressed in the literature. Likewise, the results of a phenomenological analyses of the charge-exchange reactions πN, KN, $\bar{K}$N are presented as well as KN and $\bar{K}$N elastic scattering at small values of the momentum transfer which were carried out taking into account the contribution of dominant trajectories and that of a secondary ρ'

trajectory in the representation of the isospin 1 amplitudes. (tr-auth)

28287 ON THE UNIVERSALITY OF A MODIFIED KNO SCALING OF CHARGE MULTIPLICITIES IN HADRONIC COLLISIONS. Moeller, R. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., B; 74: No. 1, 145-156(18 May 1974).

The extension to low energies of KNO multiplicity scaling by use of a variable $z' = (n-\alpha)/(\bar{n}-\alpha)$ is shown to hold for data on π^-p and π^+p collisions, with a reaction dependent parameter α and the same scaling curve as for pp collisions. $(\bar{n}-a)$ is found to be common function of the cms kinetic energy Q for the three reactions. Data on beam fragmentation in pp and π^-p collisions give support to an interpretation of α as a measure of the leading particle effect. (auth)

28288 A TWO-RESONANCE ANALYSIS OF THE Q($K\pi\pi$) ENHANCEMENT. Bowler, M. G.; Dainton, J. B.; Kaddoura, A. (Oxford Univ. (UK). Nuclear Physics Lab.); Aitchison, I. J. R. (Oxford Univ. (UK). Dept. of Theoretical Physics). Nucl. Phys., B; 74: No. 3, 493-523(4 Jun 1974).

A model of the Q enhancement in $K\pi\pi$ spectra is constructed in which the Q is regarded as dominated by diffractive production of two 1^+ mesons. It is shown that the model accounts satisfactorily for the $K\pi\pi$ mass spectrum in the Q region and for the relative amounts of ρK and $K^*\pi$ as a function of mass. Regarding the A1 phenomenon as a diffractively produced meson, the derived parameters are found to yield values of the A1 and B widths in accord with experiment, and their implications are studied for the A1 nonet. Predictions are made concerning Q production through strangeness and charge exchange. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 28406, 28542, and 28551.

28289 (IFVE-SPK-72-120) RESEARCH ON MUON PRODUCTION IN NUCLEON–NUCLEON INTERACTIONS AT 70 GeV. Bondarenko, G. B.; Gridasov, V. I.; Dobretsov, Yu. P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1972. 14p. INIS.

Preliminary results are given from experiments on muon production in nucleon–nucleon interactions at 70 GeV. The upper limits were established for the formation cross section of intermediate W-bosons for the boson mass interval from 3 to 9 GeV/c^2 which are 10^{-32} to 10^{-36} cm^2/sterad. (tr-auth)

28290 HYPERTRITON AS A TEST OF THEORETICAL HYPERON–NUCLEON POTENTIALS. Gibson, B.F. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544); Lehman, D.R. Phys. Rev. C 10: No. 2, 888-892 (Aug 1974).

A separable potential approximation to recent meson theoretic hyperon–nucleon potentials is made such that the low energy scattering parameters are reproduced. The resulting charge asymmetric potentials describing the $\Lambda-p$ and $\Lambda-n$ singlet and triplet interactions are used in a Faddeev–type calculation of the hypertriton binding energy. One particular one–boson exchange potential model, having effective ranges greater than 3 fm, gives a reasonable binding. (auth)

28291 UPPER BOUNDS ON MASSIVE–LEPTON–PAIR PRODUCTION, $pN \rightarrow l^+l^-X$, IN THE QUARK–PARTON MODEL. Savit, R.; Einhorn, M.B. (National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. Lett. 33: No. 6, 392-395 (5 Aug 1974).

We present rigorous bounds on the process $pN \rightarrow l^+l^-X$ derived in the context of quark–parton models. As constraints we use the positivity of the parton probability functions and data on deep inelastic leptoproduction. Generally, our upper bounds fall below the Brookhaven National Laboratory data on muon–pair production. This result forces us to conclude that the Brookhaven data do not represent the scaling limit for this process, and/or that the usual ideas of the (colored) quark–parton model are not all correct. (auth)

28292 WIDTHS OF RESONANCES AND THE SCATTERING AT HIGH ENERGIES. Tsarev, V.A. (Lebedev Inst. of Physics, Moscow). Dokl. Akad. Nauk SSSR; 212: No. 3, 588-590(21 Sep 1973). (In Russian).

It is shown that consideration of the width of resonances, exchanging in the t-channels, substantially affects the analytical properties of amplitudes in the complex plane of the angular momentum and leads to specific pp scattering behavior at high energies. (tr-auth)

28293 BEHAVIOR OF INELASTIC NUCLEON–NUCLEON CROSS SECTIONS FROM 10^2 TO 10^5 GeV. Yodh, G. B.; Wayland, J. R.; Pal, Y. (Univ. of Maryland, College Park). pp 233-254 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

Recent cosmic ray measurements of inelastic cross sections of protons on carbon, primary proton spectra and unaccompanied hadron spectra at different atmospheric depths were analyzed to derive the energy dependence of σ_{in} (p-air) from 100 to 10^5 GeV. It is shown that σ_{in} (p-air) would increase with energy above 30 GeV from 235 mb and reach a saturation value of ~350 mb, somewhere between 3000 and 10^4 GeV, if the conventional primary proton spectrum ($AE^{-1.61}$) is used. If, on the other hand, the primary proton spectrum steepens in accord with the grigorov recent measurements, σ_{in} (p-air) would rise to a broad maximum around 2000 GeV and then decrease to a plateau value of 280 mb around 3×10^4 GeV. (auth)

28294 NEUTRAL–CHARGED PARTICLE CORRELATIONS IN PROTON–PROTON COLLISIONS IN THE FRAMEWORK OF A TWO-COMPONENT MODEL. Gupta, V.; Malhorta, P. K. (Tata Inst. of Fundamental Research, Bombay). Pramana; 2: No. 6, 319-316(Jun 1974).

The data on $\bar{N}_0(n_-)$, the average number of neutrals as a function of n_-, the number of negatively charged particles produced, is fitted at 69, 205, and 303 GeV/c. The two-component model used for the charged multiplicity distribution P_n, is one which envisages two distinct types of collisions and is the simplest such model consistent with charge conservation. It is found that the data on $\bar{N}_0(n_-)$ can be fitted reasonably well. Further, results, based on this model for P_n, suggest that at 50 GeV/c, $\bar{N}_0(n_-)$ should increase linearly with n_- and that neutral-negative correlations should be present in the central component. (auth)

28295 PROBLEM OF THE ANP SYSTEM WITH THE HULTHEN POTENTIAL AND THE FADDEEV EQUATIONS. I. Bhadra, K.; Choudhury, H. R.; Gautam, V. P. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys.; 48: No. 2, 161-172(Feb 1974).

Making use of the Faddeev equations, the problem of one lambda hyperon and two nucleon three body system is worked out with the interactions between each pair of particles determined by the local Hulthen potential. The potentials between the pairs of particles are taken to be s-wave charge symmetric. The Hilbert-Schmidt separable expansion of the two body t-matrix projects the Faddeev equations in a set of one dimensional coupled integral equations. With this approach the values of the binding energy of the Λ hyperon in ${}_{\Lambda}H^3$ for different sets of the low energy $\Lambda-N$ parameters. (auth)

28296 FAST LEADING PARTICLES AND LONG-RANGE RAPIDITY CORRELATIONS BETWEEN PIONS. Pirila, P.; Pokorski, S. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 73: No. 3, 509-522(11 May 1974).

The long-range rapidity correlations between two produced particles due to the existence of very fast leading particles are calculated using the high-energy data on single diffraction dissociation as input. The method of calculation is to a large extent analytic. The long range correlations are found to be equally important as short range effects in interpreting experimental data on two-particle correlations. The results are not sensitive to the detailed properties of diffraction dissociation. (auth)

28297 THE SLOPE OF THE PROTON-PROTON SCATTERING AMPLITUDE AT t = 0. Kroll, P. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 74: No. 1, 157-166(18 May 1974).

A dispersion relation for the slope of a crossing symmetric amplitude is derived and applied in pp scattering at high energies and at t = 0. The crossing symmetric amplitude is extracted from the pp amplitude with reasonable assumptions on the crossing antisymmetric part. It is found that the slope of the imaginary part is almost equal to the slope of the modulus. The derivative of the real part is much smaller than that of the imaginary part and shows a zero at NAL energies. (auth)

28298 CORRELATIONS IN THE FINAL STATES $pp\pi^+\pi^-\pi^+\pi^-$ AND $pp\pi^+\pi^-\pi^+\pi^-\pi^+\pi^-$ FROM 28.5 GeV/c pp COLLISIONS. Hanlon, J.; Panvini, R. (Vanderbilt Univ., Nashville, Tenn. (USA)). Nucl. Phys., B; 73: No. 3, 465-476(11 May 1974).

Various invariant mass and angular distributions from the final states $pp\pi^+\pi^-\pi^+\pi^-$ and $pp\pi^+\pi^-\pi^+\pi^-\pi^+\pi^-$ are compared with the predictions of two models. The essential input to these models is the correct single-particle distributions with energy and momentum conservation constraints taken into account. The data is from 28.5 GeV/c pp interactions in the BNL 80-inch bubble chamber. Substantial agreement between the data and the models is obtained inferring that the kinematic constraints of energy and

momentum conservation play a strong role in determining correlations between particles in these high multiplicity final states. (auth)

Particle Invariance Principles and Symmetries

General

28299 HIERARCHY OF INTERACTIONS IN UNIFIED GAUGE THEORIES. Georgi, H.; Quinn, H.R.; Weinberg, S. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 33: No. 7, 451-454 (12 Aug 1974).

We present a general formalism for calculating the renormalization effects which make strong interactions strong in simple gauge theories of strong, electromagnetic, and weak interactions. In an SU(5) model the superheavy gauge bosons arising in the spontaneous breakdown to observed interactions have mass perhaps as large as 10^{17} GeV, almost the Planck mass. Mixing–angle predictions are substantially modified. (auth)

28300 MODERN DEVELOPMENTS IN THERMODYNAMICS. Gal-or, B. (Ed.). Interdisciplinary Collective Treatise. New York; John Wiley and Sons, Inc. (1974). 485p. $24.50.

The topics discussed are the largest to medium-scale irreversibilities: the new astrophysical school of unified thermodynamics, smallest-scale irreversibility; T violations and microscopic irreversibility in elementary particles, continuum and canonical thermodynamics, classical and relativistic thermodynamics, micro-instability and statistical mechanics, and philosophical problems in thermodynamics and the theory of time. (JFP)

28301 ADVANCES IN THE APPLICATION OF SYMMETRY. Ne'eman, Y. (Tel-Aviv Univ., Israel). pp 55-92 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

The accomplishments of the past decade in the application of symmetry methods to the phenomena of particle physics are reviewed. After reviewing the impact of the development of algebraic methods from the earlier group methods, the meaning of invariance and classification are reviewed in this broader context. Then the known symmetries and their interpretation in quark models are described. From these the use of higher symmetries in particle physics is investigated. (auth)

28302 CP VIOLATION. Wolfenstein, L. (Carnegie-Mellon Univ., Pittsburgh). pp 719-745 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

The discussion of CP violation includes the ideas that one can show that the hypothesis of time reversal invariance in fact does not work, that all the data that does exist so far is consistent with a one-parameter theory of the CP violation, superweak theory, the dynamical structure of the weak interactions, the existance of an intermediate vector boson which mediates the weak interactions, and the possible existence of an interaction much weaker than the weak interaction and intermediate in strength between the weak and gravitational interactions. It is noted that although there are no experiments that disprove the superweak interaction theory, the arguments given in its favor are very weak. (JFP)

28303 TOPICS IN CHIRAL SYMMETRY AND SCALE INVARIANCE. Hu, B. Ithaca, NY; Cornell Univ. (1974). 60p. University Microfilms Order No. 74-18,112.

Thesis (Ph. D.).

In addition to the chiral symmetry breaking terms $\epsilon_0\sigma_0 + \epsilon_8\sigma_8$, an isospin breaking term $\epsilon_3\sigma_3$ is included in the study of the $(3,3) \oplus (\bar{3},\bar{3})$ model. By assuming that the intermediate symmetry is either $SU_3 \otimes SU_2$ or SU_3 allowed domains for the chiral- and isospin-symmetry breaking parameters are derived. A σ-model Lagrangian is then constructed. The positivity condition for the masses reproduces the general features of the domain structure. Proceeding from the speculation that the real world is approximately $SU_4 \otimes SU_4$ and scale invariant, the mechanism of spontaneous breakdown is studied by considering a σ-type model that embodies both operator PCAC and operator PCDC. Solutions exhibiting spontaneous breakdown are analyzed in relation to the behavior of transition when explicit symmetry breaking is turned on. Allowed domains for the symmetry breaking parameters are also derived. (Diss. Abstr. Int., B)

28304 NATURE OF BROKEN SU(4) × SU(4) SYMMETRY. Kuo, T. K. (Purdue Univ., West Lafayette, IN). Phys. Rev., D; 9: No. 10, 2855-2860(15 May 1974).

If there is an additional conserved quantum number, the charm, then the relative parity between the charmed and uncharmed states is not measurable. This leads to a symmetry operator $\tilde{W}$, which turns out to be a finite rotation in SU(4) × SU(4). The existence of $\tilde{W}$ restrains the pattern of symmetry breaking. Among a number of possibilities, the most plausible is one in which SU(4) × SU(4) is first broken spontaneously down to SU(3) × SU(3) × U(1). The latter is then broken both explicitly and spontaneously to U(2) × U(1). (auth)

28305 THE SCHWINGER MECHANISM IN NON-ABELIAN GAUGE THEORIES. Sarkar, S. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 74: No. 3, 387-396(4 Jun 1974).

An alternative to the Higgs-Kibble mechanism for the formulation of spontaneously broken gauge theories has been recently proposed. It is shown how the new procedures can be generalised to the case when non-Abelian gauge groups are present. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 28510.

28306 COMMENTS ON CP VIOLATION THROUGH PHASE ANGLES IN WEAK CURRENTS, THE $\Delta I = 1/2$ RULE, AND THE RELATION $\eta_{+-} = \eta_{00}$. Morales, A.; Guillén, J.S. (Departamento de Fisica Nuclear, Universidad de Zaragoza, Zaragoza, Spain). Phys. Rev. D 10: No. 1, 350-352 (1 July 1974).

It is shown explicitly in a relativistic quark model that the approximate $\Delta I = 1/2$ rule requires that the phase angles ϕ and ξ of the axial–vector weak currents, which introduce CP violation, be opposite. (auth)

28307 TADPOLE TERM AND (8, 8) CHIRAL–SYMMETRY BREAKING. Sastry, C.V.; Tiwari, T.N. (Department of Mathematics, Regional Engineering College, Rourkela 769008, India). Phys. Rev. D 10: No. 1, 366-368 (1 July 1974).

A Coleman–Glashow–type sum rule is obtained for the electromagnetic mass differences of the pseudoscalar mesons using the SU(2) –breaking term in the (8, 8) chiral–symmetry–breaking scheme. However, the agreement with the experimental data is not as good as in the case of the $(3, \bar{3}) \oplus (\bar{3}, 3)$ model. (auth)

Applications (Strong)

28308 SYMMETRY BREAKDOWN AND SMALL MASS BOSONS. Nambu, Y. (Univ. of Chicago). pp 33-54 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

The meaning and mechanism for spontaneous breakdown of a symmetry are reviewed. After reviewing the history of the Goldstone boson, he describes the relation of the Goldstone theories to PCAC, current algebra, and soft pion limits. These problems are unified in the approach of utilizing the nonlinear realizations of the symmetries. A discussion is given. (auth)

28309 THE LADDER COMPLETE SET AND RELATIVISTIC GENERALIZATIONS. Nikolov, A. (Department of Physics, University of Sofia, Bulgaria). Ann. Phys. (N. Y.); 85: No. 2, 438-453(Jun 1974).

The ladder complete set and a classification scheme connected with it correspond to a rest system. With the help of the group $U(6,6) \cdot T(143)$, their corresponding relativistic generalizations are proposed in the present paper; for this purpose a suitable representation of the group algebra is examined, and many-dimensional momenta and angular momenta are introduced. An intermediate complete set of commuting operators is formed from the latter (an analogy with the case of the ladder representation is at hand), and the manner of extracting the physical part of the considered space is shown. This gives the possibility of forming a complete physical set, which includes also the four-momentum, and in a rest system reduces to the ladder set. (auth)

Scattering Theory

Refer also to abstracts 28601 and 28619.

28310 SINGLE–PARTICLE DISTRIBUTION IN THE HYDRODYNAMIC AND STATISTICAL THERMODYNAMIC

MODELS OF MULTIPARTICLE PRODUCTION. Cooper, F.; Frye, G. (Belfer Graduate School of Science, Yeshiva University, New York, New York 10033). Phys. Rev. D 10: No. 1, 186-189 (1 July 1974).

We find that the single-particle distribution EdN/d^3p for an expanding relativistic gas described by a distribution function obeying the Boltzmann transport equation is not of the form of an integral over collective motions of a velocity weight function times a "Lorentz-transformed" rest-frame distribution function. This casts doubt on the algorithms of Milekhin and Hagedorn for determining the single-particle distribution function in their models of particle production. For the hydrodynamic model, the correct algorithm is presented. (auth)

28311 MINIMAL THREE-BODY SCATTERING THEORY. Amado, R.D. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. Lett. 33: No. 5, 333-336 (29 July 1974).

We show that implementation via unitarity and analyticity of quantum mechanical constraints due to pair final-state interactions in three-body states leads to the simplest form of linear scattering integral equations usually used for the three-body problem. This form of the separable interaction equation is therefore the minimal equation compatible with these general constraints of quantum mechanics. (auth)

28312 TOPICS IN THE S-MATRIX THEORY OF MASSLESS PARTICLES. Auerbach, S.P.; Rosenzweig, C. (Department of Physics, University of California, Berkeley, California 94720); Pennington, M.R. Ann. Phys. (N.Y.) 85: No. 1, 214-250 (30 May 1974).

We discuss how massless particle reactions may be incorporated into standard S-matrix theory. The crucial element for doing so is a low-energy zero. Examples of reactions where such zeros occur are weak interaction processes involving neutrinos, chirally symmetric massless pion scattering, and two-photon exchange between neutral energy systems. These zeros make two-body unitarity a good approximation for sufficiently low energy despite the coalescence of multiparticle thresholds. Through two-body unitarity, these zeros produce lines of zeros in the absorptive parts and double spectral functions. These lines of zeros are the S-matrix analog of the requirement of an infrared finite field theory. Not only do they produce finite total cross sections at finite energies, but they also allow both upper and lower bounds to be derived for these cross sections at high energies. This upper bound is our main result. If a plausible smoothness assumption is made, we find $\sigma_{TOT} < s^{\epsilon}$ (where ϵ is arbitrarily small). In particular, the experimentally observed linear rise of the neutrino proton cross section cannot continue indefinitely. (auth)

28313 PHENOMENOLOGY OF HIGH ENERGY SCATTERING. Durand, L. III. (Univ. of Wisconsin, Madison). pp 171-232 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

Presenting a review of the phenomenology of high energy scattering, the strengths and weaknesses of the many techniques that have been used to analyze these data are described. Besides the standard Regge model, the models based on the use of Regge cuts and complex Regge poles are discussed. In addition the recent Serpukhov data and its implications on Regge based models are reviewed and a brief discussion of the diffraction models and the newer hybrid models is given. (auth)

28314 CONSTRUCTION OF CROSSING-SYMMETRIC UNITARY SCATTERING AMPLITUDES. Warnock, R. L. (Illinois Inst. of Tech., Chicago). pp 345-394 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

The question of how to construct scattering amplitudes which satisfy the postulates of S matrix theory is reviewed. The review traces the development of the theory from the early formulation of the Chew-Low equation to the recent proofs of existence of amplitudes with Mandelstam analyticity, crossing, and unitarity. The problem of constructing amplitudes is viewed as having two parts. The first part is to solve the partial-wave dispersion relation with given left-hand cut and given elasticity. The solution of this part by the N/D method, and the associated matter of CDD poles, is briefly summarized. The more difficult second part, which has to do with imposing crossing symmetry and Mandelstam analyticity, is considered as a problem in nonlinear functional analysis. Elementary tools of the latter subject (fixed point theorems, implicit function theorems) are introduced and applied to the Low equation and to the Mandelstam crossing-unitarity equation. Some comments are given on the outlook for S matrix dynamics. (auth)

28315 BORN SERIES FOR SCATTERING AMPLITUDES. Holt, A. R.; Santoso, B. (Essex Univ., Colchester, Eng.). J. Phys., B (London); 7: No. 9, 1018-1026(21 Jun 1974).

The convergence of the Born series for potential scattering is examined. It is demonstrated that calculations of differential cross sections using the second Born approximation can be inferior to those using the first Born approximation. Calculations using third and fourth Born approximations are also presented, and whilst it is true that the higher Born approximations are generally superior to the first Born approximation, it is clear that no definite convergence pattern exists. Following an idea of Moiseiwitsch (Proc. Phys. Soc.; 78: 616-8 (1961)), however, it is shown that it is possible to obtain accurate differential cross sections using the second Born approximation, provided that the contributions of the lowest few partial waves are suitably corrected. (auth)

28316 ON A ONE-DIMENSIONAL FOUR-BODY SCATTERING SYSTEM. Wolfes, J. (International Centre for Theoretical Physics, Trieste, Italy). Ann. Phys. (N.Y.) 85: No. 2, 454-464 (June 1974).

An exact solution is given to a four-body equal-mass linear scattering system interacting via two- and/or four-body potential. (auth)

28317 THE DISTRIBUTION OF THE ZEROES OF THE JOST FUNCTION: THE s-WAVE ATTRACTIVE EXPONENTIAL POTENTIAL. Lavine, J.P. (Physique Nucléaire Théorique, Institut de Physique, Université de Liège, Sart Tilman, 4000 Liège 1, Belgium). J. Math. Phys. (N.Y.) 15: No. 10, 1738-1739 (Oct 1974).

We show how the zeroes of the Jost function for an s-wave attractive exponential potential are distributed. In particular, we use known results, especially some of Coulomb's, on the zeroes of Bessel functions to demonstrate that there are no zeroes for complex momentum $k=k_1+ik_2$ ($k_1 \neq 0$, $k_2 \neq 0$). (auth)

28318 APPROXIMATION OF H-FUNCTION FOR ANISOTROPIC SCATTERING: I. A-Rayleigh's Phase Function. Karanjai, S.; Barman, S. K. (Univ. of North Bengal, West Bengal, India). Indian J. Phys.; 48: No. 2, 126-132(Feb 1974).

One of Karanjai's approximate forms for the H-function for isotropic scattering was extended to anisotropic scattering. The phase function considered is the Rayleigh's phase function. Comparison of calculated results with the exact values given by Chandrasekhar shows good agreement. Results were applied to find diffuse reflection according to the Rayleigh's phase function. (auth)

28319 FACTORIZATION OF DUAL LOOP AMPLITUDES BY FUNCTIONAL METHODS. I. Karpf, A. D. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 74: No. 3, 440-458(4 Jun 1974).

A generalisation of surface variational theory is shown to be a very convenient method for factorizing the residues of the poles in a chosen Chan variable of an arbitrary loop amplitude. It is possible to perform the factorization entirely in terms of these very Chan variables without resorting to operator methods which usually introduce too large a spectrum. The factors of the residues emerge directly in their final functional form as Abelian integrals and differentials on smaller Riemann surfaces and are hence immediately applicable for physical purposes. The derivations of these results are presented in a self-contained form. A possible extension to the pomeron factorisation is suggested. (auth)

28320 FACTORISATION OF DUAL LOOP AMPLITUDES. II. Unitary Planar Corrections to Leading Trajectory. Karpf, A. D. (Marburg Univ. (F. R. Germany). Fachbereich Physik); Liehl, H. J. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). Nucl. Phys., B; 74: No. 3, 459-481(4 Jun 1974).

A method is presented to factorise the Abelian integrals of an N-loop dual amplitude such that a connection with a particular Feynman-like diagram can be established. This method is applied to evaluate the unitary corrections to the leading trajectory and to perform the sum over all possible planar loops. The result is more general than previous ones and yields known bilinear differentials for the correction terms. This method can easily be extended to non-leading trajectories. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

28321 (UCSD-34P143-55) RESEARCH ON THE PROPERTIES OF MATERIALS AT VERY LOW TEMPERATURES. Annual Progress Report for July 1971–July 1972. Wheatley, J. C. (California Univ., La Jolla, San Diego (USA). Dept. of Physics). Aug 1972. Contract AT(04-3)-34. 21p. Dep. NTIS $4.25.

Research results for the period July, 1971 to July, 1972 are summarized briefly. A list of articles published in this period, those in press and submitted, Ph. D. theses accepted, patent disclosures, and other activities of the principal investigator related to his AEC supported research is attached. This report is made largely with reference to this list, though more detailed reference will be made to work which is completed but not yet written up and to work which is in progress. (MHR)

28322 (UCSD-34P143-62) RESEARCH ON THE PROPERTIES OF MATERIALS AT VERY LOW TEMPERATURES. Annual Progress Report for July 1972–July 1973. Wheatley, J. C. (California Univ., La Jolla, San Diego (USA). Dept. of Physics). Aug 1973. Contract AT(04-3)-34. 9p. Dep. NTIS $4.00.

Work done on ^{3}He and refrigeration and thermometry at ultra-low temperatures between July 1972 and July 1973 is summarized briefly. Publications for this period are listed. (MHR)

28323 GROUND STATE OF AN INTERACTING BOSON SYSTEM. Feenberg, E. (Department of Physics, Washington University, St. Louis, Missouri 63130). Ann. Phys. (N.Y.) 84: No. 1, 128-146 (15 May 1974).

The ground–state wave function for a system of interacting bosons is written in the form $\psi_0=\exp(1/2)(\Sigma_{i<j}U(r_{ij}) + \Sigma_{i<j<k} U_3(i,j,k)+\cdots)$. Assuming the existence of Fourier coefficients for the potential $V(r_{ij})$ and the correlation functions U_n, the Schroedinger equation transforms into a set of coupled nonlinear differential–integral equations for the correlation functions. A basic separation property of multidimensional Fourier series is involved in the derivation of the coupled equations. Leading terms in the formula for the energy resemble the corresponding Bogoliubov formula with a partial replacement of the interaction potential by an effective (or renormalized) potential. For a weak interaction the energy is given correctly through third–order terms. The same leading terms give a useful approximation under realistic conditions. The analysis is useful in giving connections within a wide range of methods and over a wide range of physical conditions. (auth)

28324 THE SPIN DYNAMICS OF AN ANISOTROPIC FERMI SUPERFLUID (^{3}He?). Leggett, A.J. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca New York 14850). Ann. Phys. (N.Y.) 85:. No. 1, 11-55 (30 May 1974).

In this paper we develop a general theory of the spin dynamics of anisotropic Fermi superfluids of the generalized BCS type, under conditions which should be realistic for any such phase of liquid ^{3}He occurring below 3 mK. No restrictions are placed on the nature of the pairing configuration. The system is described in terms of the total spin vector, S, and a vector T(n) which describes the amplitude and spin quantization axes of the pairs forming at a given point n on the Fermi surface; the kinematic relations between these quantities are emphasized. An approximation of the Born–Oppenheimer type is used to derive the general equations of motion of S and T; it is pointed out that relaxation of T due to collisions is inhibited by the coherent nature of the superfluid state. The equations of motion are solved for the particular case of unsaturated c.w. resonance, and it is shown that the nature of the transverse (usual) resonance spectrum is a strong function of the kind of configuration occurring; in particular, either one or two finite–frequency resonances may occur, depending on the configuration. A resonance is also predicted to occur when the r.f. field is polarized along the static external field. Specific predictions of the form of the transverse and "longitudinal" spectra are made for all the unitary $l=1$ states, and it is shown that these predictions are unaffected by renormalization effects. The "Balian–Werthamer" state is predicted to show a longitudinal resonance but no transverse shift. The theory is compared with other approaches to the problem, and its relevance to the anomalous low–temperature phases of liquid ^{3}He is discussed. (auth)

28325 PHOTOGRAPHS OF QUANTIZED VORTEX LINES IN ROTATING He II. Williams, G.A.; Packard, R.E. (University of California, Berkeley, California 94720). Phys. Rev. Lett. 33: No. 5, 280-283 (29 July 1974).

The spatial positions of discrete quantized vortex lines in rotating superfluid helium have been directly visualized by a photographic technique. The positions of the lines in the apparatus do not form a regular array. (auth)

28326 LIGHT SCATTERING BY ^{3}He–^{4}He MIXTURES NEAR THE TRICRITICAL POINT. Leiderer, P.; Watts, D.R.; Webb, W.W. (School of Applied and Engineering Physics and Laboratory for Atomic and Solid State Physics, Cornell University, Ithaca, New York 14850). Phys. Rev. Lett. 33: No. 8, 483-485 (19 Aug 1974).

Scattering intensity and related measurements have established the tricritical exponents for the divergences of the concentration susceptibility, γ, and of the correlation length for concentration fluctuations, ν, have indicated a probable value for the exponent η, and have established a region of tricritical scaling. (auth)

28327 MICROSCOPIC THEORY OF DYNAMICAL SPIN SUSCEPTIBILITY OF SUPERFLUID ^{3}He. NMR Line Shift. Takagi, S. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 51: No. 3, 674-689(Mar 1974).

An expression for the dynamical spin susceptibility is obtained for liquid ^{3}He by way of a microscopic argument. The standard RPA treatment of the spin exchange interaction, combined with a moment expansion for the nuclear dipole–dipole interaction, is shown to give a simple method of calculation. The present theory does not depend on the detailed nature of the system under consideration. It manifestly exhibits the general relation between the moment and the NMR line shift, thereby justifying the sum-rule argument of Leggett, as does the recent semi-phenomenological theory of Leggett. When specialized to the superfluid state, the present theory extends the recent results of Maki and Ebisawa to arbitrary types of pairing. A comment is added on possible paramagnon effects. (auth)

28328 DYNAMICAL SPIN SUSCEPTIBILITY OF ANISOTROPIC SUPERFLUID IN ^{3}He. II. Maki, K. (Tohoku Univ., Sendai); Ebisawa, H. Progr. Theor. Phys. (Kyoto); 51: No. 3, 690-702(Mar 1974).

As a sequel to a previous work, the dynamic susceptibility of an anisotropic superfluid ^{3}He in the A phase is studied in more detail. Particular attention is paid to the low field behavior of the transverse susceptibility, where the Larmor frequency becomes smaller than the dipole energy associated with the condensate. It is shown that the dynamic susceptibility develops two distinct resonance poles (for $\omega > 0$) in the low field region. The result is compared with a recent theory by Leggett. (auth)

28329 COLLECTIVE PROPERTIES OF PHYSICAL SYSTEMS. Proceedings of the Twenty-Fourth Nobel Symposium, Lerum, Sweden, June 12–16, 1973. Lundqvist, B.; Lundqvist, S. (eds.). Nobel Symposium 24. Medicine and Natural Sciences. New York; Academic Press, Inc. (1973). 272p. (CONF-730692-). $24.00.

Thirty-four papers are included. Separate abstracts prepared for most of the remaining paper were on solid state and liquid collective phenomena. (MHR)

For abstracts of individual papers see: 28330–28337 and 28376–28379.

28330 LOW TEMPERATURE PHASES OF LIQUID ^{3}He. Richardson, R. C.; Lee, D. M. (Cornell Univ., Ithaca, NY). pp 84-90 of Collective Properties of Physical Systems. Lundqvist, S. (ed.). New York; Academic Press, Inc. (1973).

From 24th Nobel symposium; Lerum, Sweden (12 Jun 1973). See CONF-730692-.

A brief summary is given of the recent experiments in liquid ^{3}He at very low temperatures. Several new phases of the liquid have been observed in various experiments that are discussed. (auth)

28331 EXPERIMENTAL EVIDENCE FOR SUPERFLUIDITY IN THE NEWLY FOUND PHASES OF ^{3}He. Alvesalo, T. A.; Anufriyev, Yu. D.; Collan, H. K.; Lounasmaa, O. V.; Wennerstroem, P. (Helsinki Univ. of Tech., Otaniemi, Finland). pp 91-96 of Collective Properties of Physical Systems. Lundqvist, S. (ed.). New York; Academic Press, Inc. (1973).

From 24th Nobel symposium; Lerum, Sweden (12 Jun 1973). See CONF-730692-.

The relative bulk viscosity η of liquid ^{3}He has been measured along the melting curve from 15 mK to about 1 mK with a vibrating string viscometer. As the temperature is reduced, η first increases as expected until the pressure anomaly "A" at $T_A = 2.6$ mK is reached. The viscosity then starts to decrease, has a discontinuous drop at the pressure anomaly "B", and then continues to diminish rapidly. The lowest measured value of η, approximately at 1 mK, is more than three orders of magnitude smaller than expected on the basis of the Fermi liquid theory and experimental data above T_A; this is regarded as strong evidence for superfluidity. If the two-fluid model is applied to liquid ^{3}He,

the results can be interpreted as showing that the density of the normal component rapidly diminishes below the A transition, with a corresponding increase in the density of the superfluid component. (auth)

28332 ORDER PARAMETER IN LIQUID ^{3}He. Mermin, N. D.; Ambegaokar, V. (Cornell Univ., Ithaca, NY). pp 97-102 of Collective Properties of Physical Sciences. Lundqvist, S. (ed.). New York; Academic Press, Inc. (1973).

From 24th Nobel symposium; Lerum, Sweden (12 Jun 1973). See CONF-730692-.

The melting curve data are listed which have proved especially informative in reducing the considerable range of possibilities one must face in considering ab initio the pairing problem for general pair orbital angular momentum. It is concluded that the melting curve data, the structure of the Ginzburg-Landau free energy (subject to the unitarity assumption), and the Anderson-Brinkman calculation are all compatible with a model of p-wave pairing for both A and B phases; the A phase having an Anderson-Morel type of order, stabilized by spin fluctuations, and the B, Balian-Werthamer. To confirm this picture further theoretical and experimental work is suggested. (MHR)

28333 ALIGNED ORBITAL ANGULAR MOMENTUM IN THE LOW TEMPERATURE PHASE OF ^{3}He. Anderson, P. W. (Bell Telephone Labs., Inc., Murray Hill, NJ). pp 103-108 of Collective Properties of Physical Systems. Lundqvist, S. (ed.). New York; Academic Press, Inc. (1973).

From 24th Nobel symposium; Lerum, Sweden (12 Jun 1973). See CONF-730692-.

Background information, from a physical point of view, is given on the nature of anisotropic superfluid states, and the problem of nuclear spin resonance is discussed. (MHR)

28334 NMR IN AN ANISOTROPIC SUPERFLUID (^{3}He). Leggett, A. J. (Cornell Univ., Ithaca, NY). pp 109-111 of Collective Properties of Physical Systems. Lundqvist, S. (ed.). New York; Academic Press, Inc. (1973).

From 24th Nobel symposium; Lerum, Sweden (12 Jun 1973). See CONF-730692-.

The basic experimental facts known at present about NMR in liquid ^{3}He, A and B, are reviewed. In order to construct equations of motion for total spin S and the vector T(n), the following assumptions were made. First, in the dipole Hamiltonian, only the term involving Cooper pairs is kept. Secondly, in the rest of the Hamiltonian a "Born-Oppenheimer" type of approximation is made. It is argued that for motion on the time-scale of typical NMR frequencies the system has plenty of time to follow adiabatically, so that the energy can be written as a function only of the conserved or nearly conserved quantities, i.e. of S and T(n). It is concluded that if the theory presented here is correct, NMR should prove one of the most sensitive indicators of the nature of the low-temperature phases of liquid ^{3}He. (MHR)

28335 ANISOTROPIC SUPERFLUIDS. de Gennes, P. G. (College de France, Paris). pp 112-115 of Collective Properties of Physical Systems. Lundqvist, S. (ed.). New York; Academic Press, Inc. (1973).

From 24th Nobel symposium; Lerum, Sweden (12 Jun 1973). See CONF-730692-.

It is assumed that ^{3}He in the A phase is a superfluid with P state pairing. A number of questions immediately arise at the macroscopic level-particularly the two following: (1) What kind of permanent currents can be observed? (2) What are the textures which the anisotropic superfluid will tend to realize in practice? And, in particular, how can single domains be made? An attempt is made to guess some of the answers using Landau-Ginzburg equations. (MHR)

28336 SPIN FLUCTUATIONS AND ANISOTROPIC SUPERFLUIDITY IN ^{3}He. Brinkman, W. F. (Bell Telephone Labs., Holmdel, NJ). pp 116-120 of Collective Properties of Physical Systems. Lundqvist, S. (ed.). New York; Academic Press, Inc. (1973).

From 24th Nobel symposium; Lerum, Sweden (12 Jun 1973). See CONF-730692-.

The mechanism by which spin fluctuations can stabilize an anisotropic superfluid state is briefly reviewed. Certain particle-particle diagrams omitted in the original calculation are then estimated and shown to give a small contribution to the susceptibility. The energetics of spin fluctuations in ^{3}He are discussed and it is shown that the variation in specific heat discontinuity with pressure is in agreement with the spin fluctuation prediction although the magnitude of the spin fluctuation predictions are somewhat larger than observed values. (auth)

28337 REMARKS ON THE THEORY OF THE SUPERFLUID PHASE TRANSITION IN 2-DIMENSIONAL He FILMS. Doniach, S. (Stanford Univ., CA). pp 146-148 of Collective Properties of Physical Systems. Lundqvist, S. (ed.). New York; Academic Press, Inc. (1973).

From 24th Nobel symposium; Lerum, Sweden (12 Jun 1973). See CONF-730692-.

Some work is described on the existence of a phase transition in a Ginzburg-Landau model field theory with n-component order parameter which suggests that $T_c(n) = O(1/n^2)$ for large n. An extrapolation to n = 2 is also described and an interpretation of recent measurements on ^{4}He films by Bretz in terms of a genuine 2-dimensional superfluid phase transition is suggested. (MHR)

Superconductivity

Refer also to abstracts 27403 and 28329.

28338 (AD-773099) ELECTRON SPIN RESONANCE OF A LOCALIZED MOMENT IN THE SUPERCONDUCTING STATE: BRu_2 : Gd(B = La, Ce, Th). Davidov, D.; Rettori, C.; Kim, H. M. (California Univ., Los Angeles (USA). Dept. of Physics). Jun 1973. Contract N00014-69-A-0200-4032. 27p. NTIS $3.25.

The electron spin resonance spectrum of Gd in the Type II cubic-superconductors $LaRu_2$, $CeRu_2$ and $ThRu_2$ has been observed in both the normal and superconducting regimes. Upon transition from the normal to the superconducting state, the spectra exhibit (a) a change in line shape (A/B ratio), (b) an increase in thermal broadening immediately below Tc(H), and (c) a change in g value. Comparison with experiments performed by others, as well as a preliminary interpretation of the data, are presented. (auth)

28339 (AD-773119) RE-ENTRANT CRITICAL FIELD BEHAVIOR IN $Gd_xTh_{1-x}Ru_2$: CORRELATION WITH EPR. Davidov, D.; Rettori, C.; Dixon, A.; Baberschke, K.; Chock, E. P. (California Univ., Los Angeles (USA). Dept. of Physics). Jun 1973. Contract N00014-69-A-0200-4032. 9p. NTIS $3.00.

The correlation between re-entrant critical field behavior and the EPR g shift enables the estimation of the conduction electron spin orbit scattering for the system $Gd_xTh_{1-x}Ru_2$. (auth)

28340 (AD-773913) ANALYTIC BOUNDARY FOR THE MHD MAGNETIC FIELD EQUATION. White, W. W. (Mission Research Corp., Santa Barbara, Calif. (USA)). 29 Nov 1973. Contract DNA001-73-C-0138. 27p. (MRC-R-92; DNA-3232-T). NTIS $3.25.

A magnetic field boundary condition for use with high altitude phenomenology codes has been developed. The solution of a boundary value problem in the region external to the MHD grid provides a current-free analytical approximation for the magnetic field outside the grid. The applicability of the current-free field as a boundary condition rests on the assumption that electrical currents of significance are contained within the MHD grid. Magnetic field data for a high altitude nuclear burst as computed by the MICE MHD code are presented. (auth)

28341 (AD-774073) CORRELATION BETWEEN ELECTRON SPIN RESONANCE AND SUPERCONDUCTIVITY IN $Gd_xB_{1-x}Ru_2$ (B = Th, Ce, La). Davidov, D.; Rettori, C.; Baberschke, K.; Chock, E. P.; Orbach, R. (California Univ., Los Angeles (USA). Dept. of Physics). Aug 1973. Contract N00014-69-A-0200-4032. 9p. NTIS $3.00.

Correlation between EPR and superconductivity in $Gd_xB_{1-x}Ru_2$ (B = Th, Ce, La) enables the interpretation of the behavior of the superconducting transition temperature as a function of Gd concentration in these cubic intermetallic compounds. (auth)

28342 (AD-774671) ELECTRON SPIN RESONANCE IN SUPERCONDUCTORS. Orbach, R. (California Univ., Los Angeles (USA). Dept. of Physics; Tel Aviv Univ. (Israel). Dept. of Physics). Feb 1974. Contract N00014-69-A-0200-4032. 9p. (TAUP-413-73). NTIS $3.00.

The internal field distribution in type II superconductors substantially alters the electron spin resonance g value and line shape. The resulting changes can be used to determine both the width and approximate shape of the internal field distribution. (auth)

28343 (AD-776949) SUPERCONDUCTING THIN FILMS IN THE NIOBIUM-VANADIUM AND TITANIUM-TANTALUM SYSTEMS. Report for July 1972-July 1973. (Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. (USA)). Feb 1974. 12p. (USAMERDC-2088). NTIS $3.00.

Thin films of Nb-V and Ti-Ta alloys have been deposited by dc co-sputtering onto fused quartz at substrate temperatures of 700C. Deposition rates averaged 100A per minute and the thick-

ness of all samples was of the order of 3000A. J_c–H characteristics were measured by a pulsed field–pulsed current technique and T_c's by monitoring the electrical resistance with temperature. T_c's in the Ti–Ta system are generally lower than in bulk, but considerably higher in the Nb–V system. The J_c's in both systems are comparatively high at low fields, but fall off rapidly with increasing magnetic fields. (auth)

28344 (AED-CONF-74-089-003) SUPERCONDUCTIVITY OF VERY THIN Al-, In- AND Pb-LAYERS. Gromer, J.; Stxl, H. (Stuttgart Univ. (TH) (F. R. Germany). 3. Physikalisches Inst.). 1974. 26p. (CONF-740451-4). (In German). INIS.

From spring meeting of the Arbeitsgruppe Festkoerperphysik of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

10 figs.; 5 tabs.; 29 refs. With abstract.

A report is given on tunnel spectroscopical investigations and T_c measurements on thin super conducting aluminium, indium and lead evaporated films. Naphthalene and silicon monoxide (SiO) were used as film base (and simultaneously as insulator layer between both metal layers of the tunnel diode). The investigations dealt with: 1.) The changes of the transition temperature, the energy gap and the state density of superconductors on the film surface compared with the inner part of the film, 2.) the effects of resulting quantization of the electron and phonon states with the thinnest films (quantum size effect), and the effects on the tunnel spectra, energy gaps and transition temperatures, 3.) the destruction of superconducting at the critical layer thickness, 4.) the influence of superconducting by contact of the metals with the SiO and naphthalene bases. (GE)

28345 (AED-CONF-74-089-031) SUPERCONDUCTION OF Th_4H_{15} UNDER PRESSURE. Abstract. Dietrich, M.; Gey, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik; Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Experimentelle Kernphysik). 1974. 2p. (CONF-740451-6). (In German). INIS.

From spring meeting of Arbeitskreis Festkoerperphysik of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

With related material.

In order to understand the superconduction of thorium hydride Th_4H_{15}, pressure tests (up to 28 Kbar) were carried out with a new measuring equipment in which the detection sample is in a liquid pressure medium for magnetic T_c determination and surrounds the sample. T_c increases relatively strongly with the pressure (straiting gradient 42 mK/Kbar). To interpret the results a comparison was made with uranium. (GE)

28346 MICROWAVE SURFACE RESISTANCE OF SUPERCONDUCTING $Mo_{0.75}Re_{0.25}$. Yasaitis, J.A.; Rose, R.M. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Appl. Phys. Lett. 25: No. 6, 354-355 (15 Sept 1974).

A $Mo_{0.75}Re_{0.25}$ alloy endplate was tested on a Nb TE_{011} mode microwave cavity resonant at 11.2 GHz. An upper bound for the surface resistance of 2.8 $\mu\Omega$ and a lower bound of 102 G for the microwave magnetic breakdown field were established for the alloy plate. Comparison of these results to current requirements for a superconducting linear accelerator demonstrated the potential feasibility of this alloy as a practical alternative to Nb and Pb for accelerator applications. This is the first alloy shown to be a potential alternative to Nb and Pb and arguments are presented which indicate possible practical advantages of $Mo_{0.75}Re_{0.25}$ over Nb and Pb. (auth)

28347 QUASIPARTICLE LIFETIMES AND MICROWAVE RESPONSE IN NONEQUILIBRIUM SUPERCONDUCTORS. Rothwarf, A.; Sai–Halasz, G.A.; Langenberg, D.N. (Department of Physics and Laboratory for Research on the Structure of Matter, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. Lett. 33: No. 4, 212-215 (22 July 1974).

A theoretical treatment is presented of the quasiparticle–recombination dynamics of a nonequilibrium superconductor. The microwave reflectivity of a superconducting film in the presence of external pair breaking is calculated. It is shown how microwave experiments may permit the separation of the effective recombination time into its intrinsic and recombination–phonon components. (auth)

28348 EFFECTS OF DYNAMIC EXTERNAL PAIR BREAKING IN SUPERCONDUCTING FILMS. Sai–Halasz, G.A.; Chi, C.C.; Denenstein, A.; Langenberg, D.N. (Department of Physics and Laboratory for Research on the Structure of Matter, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. Lett. 33: No. 4, 215-219 (22 July 1974).

Effects of dynamic external pair breaking in superconducting films are studied using microwave reflectivity to probe excess quasiparticle densities. For weak pair breaking, agreement with theory is good, permitting determination of effective quasiparticle recombination times. For strong pair breaking, an expected first–order transition to the normal state is not observed. Instead, a partially dc–resistive state is found in a broad injection region. (auth)

28349 POSSIBILITY OF A PRESSURE–INDUCED TRANSFORMATION IN CUBIC (A15) V_3Si. Blaugher, R.D.; Taylor, A.; Ashkin, M. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). Phys. Rev. Lett. 33: No. 5, 292-295 (29 July 1974).

X–ray measurements of the shift in lattice parameter $\Delta a/a$ versus pressure up to 120 kbar indicate that V_3Si is not following a normal cubic dependence for a stable lattice. Hydrostatic pressures in excess of 15 kbar have produced a lattice distortion which may be representative of a cubic to tetragonal transformation. (auth)

28350 CRITICAL CURRENT DENSITY OF A SUPERCONDUCTING COPPER–BASE ALLOY CONTAINING Nb_3Sn FILAMENTS. Tsuei, C.C. (W. M. Keck Laboratory of Engineering Materials, California Institute of Technology, Pasadena, California 91109); Suenaga, M.; Sampson, W.B. Appl. Phys. Lett. 25: No. 5, 318-320 (1 Sept 1974).

The critical current density J_c of 0.25–mm $Cu_{88.5}Nb_{10.0}Sn_{1.5}$ and $Cu_{83.5}Nb_{15.0}Sn_{1.5}$ wires has been measured at 4.2 °K as a function of magnetic field H up to 100 kG. A typical value of J_c at H=O is $\sim 10^5$ A/cm^2 indicating that the critical current density of the Nb_3Sn filaments is probably of the order of 10^6 A/cm^2. Mechanical deformation such as bending some of the wire samples around a 1/2–in.–diam mandrel does not produce any significant degradation of J_c at H=40 kOe. (auth)

28351 SHIELDING OF A MAGNETIC FIELD BY A HARD SUPERCONDUCTOR. Chizhov, A.K. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Tech. Phys. 18: No. 11, 1499-1503 (May 1974).

The mechanisms responsible for the shielding of magnetic fields by superconductors in the Bean "critical state" are discussed on the basis of an analysis of the shielding characteristics [the magnetic field attenuation K=f(H), the "puncture" field H_p, and the "frozen–in" field H_f] and their functional dependences on the dimensions and the rate of change of the magnetic field. There are three basic mechanisms, which are governed by the intensity of the actuating field alone, not by its rate of change or orientation with respect to the shield surface. The characteristics of tubular shields of the alloy Pb_{50}–Bi_{50} are analyzed as functions of the wall thickness w and the orientation and rate of change of the magnetic field. Equations are derived for H_p, H_f, and K=f(H) for various field regions. Over most of the working–field region $H_{c1} \leqslant H \leqslant H_1$ the coefficient K can be found from $K = (B_0/H) \times [\sqrt{(1+H/B_0)^2 - (2\alpha cw)/B^2_0} - 1]$, where $c = 0.4\pi$ G·cm/A, and α and B_0 are parameters of the shield, functions of its structure and temperature as well as of the field orientation. These parameters are determined from magnetic measurements of a specimen of a given size with $w > w_{th}$ (w_{th} is the threshold wall thickness). (auth)

28352 RESISTIVITY OF TIN FILMS NEAR THE SUPERCONDUCTING TRANSITION. Gerasimov, N.P.; Pozharov, A.M.; Reinov, N.M. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Tech. Phys. 18: No. 11, 1544-1545 (May 1974).

The characteristics of superconducting transitions of tin films are analyzed. For an analytic description of the film resistance R_T for $T > T_c$ near the transition an empirical factor θ is proposed, from which R_T can be determined for various currents through the film. The value R_T is found experimentally to asymptotically approach the residual resistance with increasing temperature. (auth)

28353 DISTRIBUTION OF THE TRAPPED MAGNETIC FIELD IN A DOUBLY CONNECTED CYLINDRICAL SUPERCONDUCTOR. Bondarenko, S.I.; Sheremet, V.I.; Vinogradov, S.S. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Tech. Phys. 18: No. 11, 1438-1440 (May 1974).

The homogeneity and stability of the magnetic field trapped in a thick–walled superconducting cylinder are investigated. Expressions for the components of the magnetic field in the entire domain external to the superconductor are derived for an infinite plate containing a cylindrical hole. A numerical calculation of the magnetic field is carried out. The stability of the trapped magnetic field and the field distribution along the cylinder axis are studied experimentally for various length–to–diameter ratios of the cavity and various gradients of the external magnetic field. (auth)

28354 PRODUCTION OF ULTRAWEAK MAGNETIC FIELDS WITH SUPERCONDUCTORS. Sheremet, V. I.; Bondarenko, S. I. Krlog. Vak. Tekh.; No. 2, 110-116(1972). (In Russian).

A superconducting screen offers the possibility of obtaining an area with an ultraweak magnetic field (extreme magnetic vacuum). Experiments are described in which by the use of different methods a constant magnetic field of less than 10^{-5} to 10^{-6} G was pro-

duced in a volume of the order of several hundred cm^3. Use of the effect of quantization of the magnetic current in multiply connected superconductors can produce areas in which the magnetic field is practically zero. Superconducting screens with extreme magnetic vacuum are necessary for the solution of many problems connected with production of instruments for new techniques, for study of the permanent stability and calibration of highly sensitive magnetometric devices, and for various studies in physics and biology. (tr-auth)

28355 MAGNETIC FIELD ATTENUATION BY THIN SUPERCONDUCTING LEAD FILMS. Kerchner, H.R.; Ginsberg, D.M. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Rev. B 10: No. 5, 1916-1926 (1 Sept 1974).

Measurements have been made of the attenuation of an axial dc magnetic field by cylindrical thin films of superconducting lead. The normal-state resistance of each film was measured to determine the film thickness and the electron mean free path. The results have been used to derive the superconducting conductivity and the London-limit penetration depth $\lambda_L(T)$, and to infer the penetration depth $\lambda(T)$, which would be expected for pure bulk lead. Our experimental results for the temperature dependence of the superconducting conductivity and its value in the limit of zero temperature show unmistakable strong-coupling effects which agree well with our own theoretical calculations from previously obtained tunneling data and with published zero-temperature theoretical values. The analysis of the data indicates that $\lambda_L(0) = 315 \pm 7$ Å and the bulk zero-temperature penetration depth $\lambda(0)$ should be 453 ± 8 Å. (auth)

28356 ULTRASONIC-ATTENUATION DETERMINATION OF THE ANISOTROPIC ENERGY GAP IN SUPERCONDUCTING ZINC. Cleavelin, C.R.; Marshall, B.J. (Department of Physics, Texas Tech University, Lubbock, Texas 79409). Phys. Rev. B 10: No. 5, 1902-1911 (1 Sept 1974).

Measurements of the ultrasonic attenuation in normal and superconducting high-purity zinc single crystals have been conducted for longitudinal sound waves propagating in the [0001], [1010], and [11$\bar{2}$0] crystallographic directions. Analysis of the data has been presented in terms of the BCS theory of superconductivity and the Pippard theory of ultrasonic attenuation. The analysis indicates the effective 0-K energy gap is highly anisotropic ($\langle a^2 \rangle \simeq 0.04$). The analysis also indicates multiple-gap and frequency-dependent behavior of the energy gap for ultrasound propagating in the [1010] and [11$\bar{2}$0] directions for $ql \sim 1$. For zinc, this behavior has been attributed to anisotropy on the Fermi surface and not to multiple energy surfaces occurring in the higher Brillouin zones. (auth)

28357 INDUCTIVE TRANSITION OF NIOBIUM AND TANTALUM IN THE 10-MHz RANGE. I. ZERO-FIELD SUPERCONDUCTING PENETRATION DEPTH. Varmazis, C. (Columbia University, New York, New York 10027 and Brookhaven National Laboratory, Upton, New York 11973); Strongin, M. Phys. Rev. B 10: No. 5, 1885-1895 (1 Sept 1974).

The inductive transition of superconducting Nb and Ta was investigated at 15 MHz. These measurements provide values of $\lambda_L(0)$ for both Nb and Ta which are compared with other work. Particular attention has been given to impurities at the metal surfaces, and to how λ is affected through a change in the boundary condition on the Ginzburg-Landau order parameter. We emphasize that in accurate measurements the surface must be characterized by a parameter describing the slope of the order parameter at the surface. A peak in the inductive skin depth has been observed in the region very close to T_c, where $\lambda > \delta$, and this allows T_c to be determined very precisely. (auth)

28358 TEMPERATURE DEPENDENCE OF THE MAXIMUM (dc) JOSEPHSON CURRENT. Balsamo, E.P.; Paternò, G. (Laboratori Nazionali del Comitato Nazionale per l'Energia Nucleare, Frascati, Italy); Barone, A.; Rissman, P.; Russo, M. Phys. Rev. B 10: No. 5, 1881-1884 (1 Sept 1974).

Experimental investigation on the temperature dependence of the maximum Josephson current (dc) has been performed on both symmetrical and asymmetrical junctions. Agreement with the Ambegaokar and Baratoff calculations has been found for both Sn-Sn_xO_y-Sn and Sn-Sn_xO_y-Pb junctions. Experimental results on Sn-Sn_xO_y-In structures have also been obtained. (auth)

28359 ULTRASONIC ATTENUATION IN THE MIXED STATE OF VANADIUM. Waynert, J.A.; Salvo, H. Jr.; Levy, M. (Physics Department, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201). Phys. Rev. B 10: No. 5, 1859-1864 (1 Sept 1974).

Electron-phonon interaction is studied in the mixed state of a type-II superconductor using a single-crystal vanadium sample. The ultrasonic-attenuation coefficient of longitudinal waves at 135 MHz and transverse waves at 255 MHz propagating along the [110] direction and parallel to the applied magnetic field are compared to the theory of Houghton and Maki. Good quantitative agreement is obtained with this sample which has a resistivity ratio of 20. (auth)

28360 DYNAMICAL PROPERTIES OF TYPE-II SUPERCONDUCTORS: AN EXPERIMENTAL STUDY. Brunet, Y.; Monceau, P. (Centre de Recherches sur les Très Basses Températures, Centre National de la Recherche Scientifique, Cédex 166, 38042 Grenoble, France); Waysand, G. Phys. Rev. B 10: No. 5, 1927-1942 (1 Sept 1974).

We report on surface-resistance measurements of bulk dirty type-II superconductors in the principal orientations between the static magnetic field H, the microwave electric field, and the surface of the sample. When the specimen is in the mixed state, we compare our results with those recently published by Pedersen et al. and we emphasize the difficulties inherent in obtaining the conductivity at H_{c2}. When H is parallel to the surface of the sample, the conductivity of the surface sheath is strongly anisotropic. The anisotropy can easily be measured by the ratio of the slopes of the surface resistance in the vicinity of H_{c3} in the two orientations where the microwave electric field is parallel or perpendicular to H. We find, as calculated by Thompson, that this anisotropy is temperature independent within a large range of temperature, and equal to 1 at T_c. These results are in agreement with the formalism of the fluctuations of the order parameter which was first developed by Caroli and Maki. A careful study shows that the anisotropy has a very sharp peak, higher than 1, in the vicinity of T_c, depending on the κ of the sample. The temperature dependence of the anisotropy, as previously reported by Maki and Fischer, can be explained by the bad state of the surface of their samples, or by a misalignment between H and the surface. We also discuss the notion of "nascent vortices" used as an alternative explanation for the anisotropic conductivity of the surface sheath. Finally, we give some results on the angular dependence of the surface impedance. (auth)

28361 ANOMALOUS HEAT CAPACITY OF SUPERCONDUCTING VANADIUM. Sellers, G.J.; Paalanen, M.; Anderson, A.C. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Rev. B 10: No. 5, 1912-1915 (1 Sept 1974).

Introduction of H or D into V produces a specific-heat anomaly in the superconducting state near 1 K which can dominate the normal lattice contribution. No evidence is found in the heat capacity for a second, very small superconducting energy gap. (auth)

28362 PHASE TRANSITION AT H_{c1} FOR SUPERCONDUCTING Nb AND V. Wollan, J.J.; Haas, K.W.; Clem, J.R.; Finnemore, D.K. (Ames Laboratory U. S. Atomic Energy Commission and Department of Physics, Iowa State University, Ames, Iowa 50010). Phys. Rev. B 10: No. 5, 1874-1880 (1 Sept 1974).

Magnetization curves for V and Nb have been studied to look for a first-order transition at H_{c1} and to determine the temperature interval in which the interaction between quantized vortices is attractive. Both the Nb sample with resistivity ratio of $\Gamma \simeq 1000$ and the V sample with $\Gamma \simeq 1500$ show a very sharp rise in magnetic induction at H_{c1} which is reminiscent of a first-order transition. The values of vortex spacing derived from the magnitude of this abrupt rise, agree well with the decoration technique at 1.2 K and the neutron-diffraction technique at 4 K. As the temperature increases, the magnetic-induction curves near H_{c1} retain the same shape for all temperatures up to reduced temperatures above 0.95. Hence there is no evidence in the magnetization data for a changeover from an attractive to a repulsive interaction in this temperature range. The detailed shape of the phase-transition curves near H_{c1} agrees fairly well with model calculations which include only bulk pinning. (auth)

28363 ANOMALOUS HYSTERESIS LOSS IN SUPERCONDUCTING WIRE DUE TO FLUX JUMP. Shiiki, K.; Kudo, M. (Central Research Laboratory, Hitachi Ltd., Kokubunji, Tokyo, Japan). J. Appl. Phys. 45: No. 9, 4071-4075 (Sept 1974).

A sudden increase in the hysteresis loss of nonideal type-2 superconductors having high critical current density was observed in the ac magnetic fields for frequencies from 35 to 100 Hz. This anomaly, which is reproducible in the sample, occurs at a peak field of about 2500 Oe in the transverse configuration and depends slightly on the frequency. It can be understood on the basis of the limited flux jump. The diameter dependence of the anomaly for Nb-60.2 Ti-2.8 Zr superconducting wires is studied over a range from 45 to 508 μm. It follows that the critical diameter necessary for adiabatic stability is about 27 μm. (auth)

28364 EFFECTS OF HEAT TREATMENT AND DOPING WITH Zr ON THE SUPERCONDUCTING CRITICAL CURRENT DENSITIES OF MULTIFILAMENTARY Nb_3Sn WIRES. Suenaga, M.; Luhman, T.S.; Sampson, W.B. (Division of Metallurgy and Materials Science, Brookhaven National Laboratory, Upton, New York 11973). J. Appl. Phys. 45: No. 9, 4049-4053 (Sept 1974).

Various wire samples consisting of 19-Nb_3Sn filaments in a normal metal matrix were made by heat treating composite wires of 19-Nb, Nb-0.5 wt% Zr, Nb-0.75 wt% Zr, and Nb-2.5 wt% Zr filaments embedded in a Cu-10 wt% Sn matrix. The Nb-0.75 wt% Zr rod contained the precipitate ZrO_2, while the Zr in the remaining Nb rods was in solid solution. The over-all size of the composite was

2.5×10^{-2} cm and each filament was approximately 2.5×10^{-3} cm in diameter. The critical current density J_c at 4.2 °K was measured at 40 and 100 kG for a variety of heat treatments. It was found that the critical current density was a strong function of the thickness of the Nb_3Sn layers formed during heat treatment. This dependence of J_c on the thickness d could be approximately represented by the expression $J_c(d) \simeq J_0 \exp(-nd)$, where J_0 is the extrapolated zero thickness critical current density. J_0 was found to be approximately 2.4×10^6 A/cm² at 40 kG for the Nb_3Sn formed from pure Nb, 1.2×10^6 A/cm² for Nb doped with solid–solution additions of Zr, and 9.5×10^5 A/cm² for that formed from Nb doped with ZrO_2. The exponent n falls in the range $0.52-0.67\ (\mu m)^{-1}$ for pure Nb_3Sn depending on heat treatment temperature, $0.154-0.287\ (\mu m)^{-1}$ for Nb doped with solid–solution additions of Zr, and only $0.11\ (\mu m)^{-1}$ for the Nb_3Sn composite wire containing ZrO_2. The magnetic field dependence of J_c for some of the composites was also measured to 150 kG. (auth)

28365 PHYSICAL PRINCIPLES OF JOSEPHSON'S EFFECTS. Odehnal, M. (Ustav Jaderne Fyziky, Rez, Czech.). Cesk. Cas. Fys.; 24: No. 4, 334-355(1974). (In Czech).

In this review article the physical principles of Josephson's effects, related to the creation of a weak coupling between two bulk superconductors, are discussed. These effects are a very clear illustration of the quantum behavior of superconductivity in macroscopic scale and demonstrate the physical reality of the phase difference of macroscopic wave functions of two weakly coupled superconductors. (auth)

28366 DYNAMICS OF THE THEORY OF THE COEXISTENCE OF SUPERCONDUCTIVITY AND FERROMAGNETISM. I. Ideal Ferromagnetic Crystal. Izyumov, Yu. A.; Skryabin, Yu. N. (Inst. of Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 37: No. 5, 921-929(May 1974). (In Russian).

Equations of the Eliashberg type, taking into consideration the interaction of electrons both with phonons and with spin waves, were derived for superconducting ferromagnetic metals. In the weak bond approximation an equation determining the temperature of the superconducting transition T_c as a function of parameters (sizes of the exchange superposed magnetizing fields, widths of the spin-wave spectra, and energy of the intraelectron repulsion through spin waves) was obtained. Each of these parameters leads to a sharp decrease of T_c. (tr-auth)

28367 LIFETIME OF A QUASIPARTICLE IN A CURRENT-CARRYING SUPERCONDUCTOR. Bar'yakhtar, V. G.; Seminozhenko, V. P. (Donets Physical-Technical Inst., USSR). Sov. Phys.-Solid State (Engl. Transl.); 15: No. 12, 2490-2491(Dec 1973).

Translated from Fiz. Tverd. Tela; 15: No. 12, 3728-3730(Dec 1973).

The lifetime τ_R of a quasiparticle is considered, when two quasi particles recombine emitting a phonon, and a Cooper pair decays absorbing a phonon in a superconductor carrying a superconducting current at a velocity v_s. The equations derived indicate that the lifetime of a quasi particle in a current-carrying superconductor may differ considerably from the corresponding lifetime in the absence of a current. (MHR)

28368 SUPPRESSION OF SUPERCONDUCTIVITY IN RUTHENIUM ALLOYS. Williams, G. (Univ. of Manitoba, Winnipeg). Solid State Commun.; 14: No. 7, 649-652(1 Apr 1974).

28369 INFLUENCE OF A TRANSVERSE CONDUCTANCE ON CURRENT SHARING IN A TWO-LAYER SUPERCONDUCTING CABLE. Turck, B. (CEN de Saclay, Gif-sur-Yvette, France). Cryogenics; 14: No. 8, 448-454(Aug 1974).

A simplified model is used to study the current sharing in a two-layer superconducting cable. Since the matrix in the case of the composites, and the copper oxide in the case of the cables, are conductors, wires can be coupled together electrically so that the resulting current redistribution no longer depends only on the mutual and self-inductance coefficients. The boundary conditions assigned by the series resistance at the input terminals then lead to a particular sharing which propagates along the conductor according to a diffusion equation. Several typical examples are calculated which point out the absolute necessity of using fully transposed cables to achieve equal sharing for pulsed currents. The transverse conductance associated with series resistance can help distribution for very slowly rising currents in small coils. Also it can help to carry the current when a wire happens to return to the normal state or be broken in a pulsed magnet. (auth)

28370 CONTRIBUTION TO THE STATIC HEAT TRANSFER TO BOILING LIQUID HELIUM. Jergel, M. (Slovenska Akademia Vied, Bratislava); Stavenson, R. Cryogenics; 14: No. 8, 431-433 (Aug 1974).

Aluminium is now being used as a stabilizing material for superconducting materials. With regard to its use as a stabilizer, the heat transfer properties to boiling helium of 99.9999% pure aluminium are measured and compared with those of 99.999% pure aluminium and OFHC copper. (auth)

28371 SUPERCONDUCTIVITY OF PALLADIUM AND Pd-ALLOYS CHARGED WITH H OR D BY ION IMPLANTATION AT HELIUM TEMPERATURES. Buckel, W.; Stritzker, B. (Kernforschungsanlage, Juelich, Ger.). pp 3-13 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

The production of metastable systems by means of ion implantation into a substrate held at liquid helium temperature is considered. Superconducting Pd–H alloys were prepared by H implantation. In contrast to the dilute alloys normally achieved by ion implantation, metastable alloys were produced with very high concentrations of the implanted atoms. (MHR)

28372 ION IMPLANTATION IN SUPERCONDUCTING THIN FILMS. Meyer, O.; Mann, H.; Phrillingos, E. (Kernforschungszentrum, Karlsruhe, Ger.). pp 15-26 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

Selected ions were implanted at room temperature in thin films of the transition metal superconductors Ti, Zr, V, Nb, Ta, Mo, W and Re, the A-15 compound Nb_3Sn and the interstitial compounds NbC and NbN with NaCl structure. Both chemically active and inert ions were used in order to distinguish between radiation damage and other effects influencing the superconducting transition temperature T_c. Successively larger decreases in T_c, due to radiation damage, were obtained for NbC, NbN, Mo, Ta, V, Nb and Nb_3Sn in that order. Chemically active ions were found to produce the same reduction in T_c as inert ions in Ta, V, Nb and Nb_3Sn, whereas in those materials in which radiation damage is less influential, namely NbC, NbN, Mo, W and Re, T_c enhancement was found to occur and was dose-dependent. (auth)

28373 ION IMPLANTATION EFFECTS IN SUPERCONDUCTING NIOBIUM THIN FILMS. Crozat, P. (CNRS, Orsay, France); Adde, J.; Chaumont, J.; Bernas, H.; Zenatti, D. pp 27-33 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

Critical temperatures and normal resistances were measured on thin niobium films after implantation of N, O, Nb and Er ions at doses ranging from 10^{13} to 10^{17} ions/cm². Radiation damage and magnetic impurity effects are presented. Implantation effects in thin superconducting Nb films were studied by measuring the variation of the critical temperature T_c and of the normal resistance near T_c as a function of the implanted ion's nature and concentration. Thin Nb films were deposited on silicon substrates. To obtain high quality superconducting films, Nb was evaporated with an electron gun on the heated substrates (400°C) in a clean high vacuum ($< 10^{-8}$ Torr). Special care was taken to eliminate impurities (especially oxygen) as Nb is an excellent getter. After evaporation and cooling down of the substrates, a gold film (2000 Å) is immediately deposited over the Nb film before opening the bell jar, both to protect the film against oxidation during storage of the samples and to make good electrical contacts. Nb films of thickness 500-600 Å are thus obtained with $T_c \sim 8.5$°K and a resistivity ratio $\rho_{300°K}/\rho_{T°K} \sim 2.8$. This high ratio is indicative of the Nb films' good quality. The sample shape shown is obtained from these films using standard photomasking and etching techniques. (auth)

28374 SUPERCONDUCTING PROPERTIES OF THE DILUTE MAGNETIC ALLOYS Pb–Mn, Sn–Mn, AND Hg–Mn OBTAINED BY ION IMPLANTATION. Buckel, W.; Heim, G. (Univ., Karlsruhe, Ger.). pp 35-45 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

The use of the implantation technique for homogeneously doping film-targets is discussed. Results are presented for superconducting films of Pb, Sn, and Hg, concerning the change of the transition temperature and the residual resistivity after implantation of Mn-ions. These results are presented to clarify the advantages and limitations of ion implantation as a technique to prepare dilute magnetic alloys. (MHR)

28375 ION IRRADIATION AND FLUX PINNING IN TYPE II SUPERCONDUCTORS. Freyhardt, H. C.; Taylor, A.; Loomis, B. A. (Argonne National Lab., IL). pp 47-59 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1974).

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973). See CONF-731028-.

Niobium foils containing 10 and 900 wt ppM oxygen were irradiated with 3.5 MeV $^{58}Ni^{+}$ to between 50 and 100 displacements per atom. The irradiation at 900°C produced a bimodal void distribution with a large number of small voids and with large diameter voids that act as strong pinning centers for fluxoids in type-II superconductors. Transverse critical current measurements showed a substantial increase in both the upper critical field H_{c2} and the critical current density J_c. J_c was anisotropic and exhibited a maximum for fluxoids parallel to the irradiated surface. From the void size and number densities, determined by transmission electron microscopy, interaction forces between fluxoids and voids as well as volume pinning forces are estimated and compared with the experimental results. (auth)

28376 ONE-DIMENSIONAL CHAINS IN THE A-15 STRUCTURE AND THE PROPERTIES OF SUPERCONDUCTORS OF THIS GROUP. Gor'kow, L. P. (Landau Inst. of Theoretical Physics, Moscow). pp 122-128 of Collective Properties of Physical Systems. Lundqvist, S. (ed.). New York; Academic Press, Inc. (1973).

From 24th Nobel symposium; Lerum, Sweden (12 Jun 1973). See CONF-730692-.

It was pointed out previously that in these compounds three orthogonal systems of the linear atom chains of the transition elements could be considered as one-dimensional threads. A one-dimensional character of the electronic spectrum in the thread is suggested as the picture is considered which follows in case the Fermi level is at the point X of the inverse lattice. It is supposed that d-electrons are localized on the threads and do not mix up with s-electrons. From the point of view shown here any quasi one-dimensional system characterized by a structural instability or anomalous temperature dependence of susceptibility is to be suspected of the possibility of antiferromagnetism or superconductivity. (MHR)

28377 (TTF) (TCNQ): A ONE-DIMENSIONAL ORGANIC METAL. Garito, A. F.; Heeger, A. J. (Univ. of Pennsylvania, Philadelphia). pp 129-141 of Collective Properties of Physical Systems. Lundqvist, S. (ed.). New York; Academic Press, Inc. (1973).

From 24th Nobel symposium; Lerum, Sweden (12 Jun 1973). See CONF-730692-.

The physics of the organic charge transfer salts is discussed from the point of view of achieving and stabilizing the one-dimensional metallic state. The particular case of (TTF) (TCNQ) is discussed in detail. Conductivity, infrared properties, magnetic susceptibility, nuclear relaxation rates and thermoelectric power data are summarized, and analyzed in terms of the properties of this one-dimensional metal. The giant conductivity peak is discussed and interpreted in terms of superconducting fluctuation phenomena. The sources of electron-phonon interaction in such narrow band ionic metals are clarified, including the effect of electronic screening. (auth)

28378 FROEHLICH'S MODEL OF ONE-DIMENSIONAL SUPERCONDUCTIVITY. Schrieffer, J. R. (Univ. of Pennsylvania, Philadelphia). pp 142-144 of Collective Properties of Physical Systems. Lundqvist, S. (ed.). New York; Academic Press, Inc. (1973).

From 24th Nobel symposium; Lerum, Sweden (12 Jun 1973). See CONF-730692-.

The recent experimental results of Coleman, Garito, Heeger, [Solid State Comm., 12, 1125(1973)] on organic charge transfer salts show a dramatic rise of the electric conductivity σ in the material ATTF-TCNQ in the vicinity of 60 K. The authors have suggested that the sharp rise in σ results from paraconductivity fluctuations into a pairing type of superconducting state, in which the pairing interaction is enhanced by a soft phonon mode at the Brillouin zone boundary $Q = \pm \pi/a$, where a is the intermolecular spacing along the chains. This is considered relative to Froehlich's twenty-year old proposal on the basis of a one-dimensional coupled electron-phonon model that a superconducting state could occur in which a periodic lattice distortion of wave number $Q = 2K_F$ caused by the electron-phonon interaction, moves with constant speed carrying with it an electron current. It is concluded that it would appear that the pairing state is more likely the proper explanation of the observed conductivity rise in the experiments of Heeger, Garito, et al. (MHR)

28379 LAYERED SUPERCONDUCTORS. Luther, A.; Beasley, M. R.; Klemm, R. A. (Harvard Univ., Cambridge, MA). pp 149-151 of Collective Properties of Physical Systems. Lundqvist, S. (ed.). New York; Academic Press, Inc. (1973).

From 24th nobel symposium; Lerum, Sweden (12 Jun 1973). See CONF-730692-.

Some properties of layered superconductors intercalculated with organic molecules are examined, which are unique and outside the framework of ordinary anisotropic type-II superconductivity. Using the phenomenological model of Lawrence and Doniach, the superconducting fluctuation contributions to the diamagnetic susceptibility, conductivity, and NMR relaxation above T_c were computed, along with studies of the establishment of the three-dimensional ordering at T_c. The results indicate that the fluctuation contribution can be two-dimensional well above T_c, and become three-dimensional at a crossover temperature $T_0 > T_c$, which depends on the weak inter-layer coupling. (MHR)

Equipment and Devices

Refer also to abstracts 26711 and 28321.

28380 (AD-774892) REFRIGERATION OF SUPERCONDUCTING ROTATING MACHINERY. Interim Report, 14 April 1972-30 June 1973. Arp, V. D. (National Bureau of Standards, Boulder, Colo. (USA)). Jun 1973. 76p. (NBSIR-73-331). NTIS $7.00.

Recent work at the NBS Cryogenics Division in three areas related to helium refrigeration is summarized: (1) Analysis is given of a possible high pressure refrigeration cycle which offers in principle a reduced component size, but which turns out to be impractical because of expansion engine inefficiencies. (2) Exact equations for flow of a real fluid are derived and applied to problems of fluid flow near the critical point, as may occur with some helium-cooled superconducting systems, and (3) Three new equations of state for helium are given, each using different state variables, to eliminate the need for iterative techniques in helium refrigeration cycle and fluid flow analysis. (auth)

28381 (AD-775228) CRYOGENIC SYSTEMS AND SUPERCONDUCTIVE POWER. Semiannual Technical Report No. 2, 1 December 1972-30 September 1973. Hatch, B. D.; Fleming, R. B.; Jones, D. W.; Kerr, D. L.; Minnich, S. H. (General Electric Co., Schenectady, N. Y. (USA). Research and Development Center). 1 Oct 1973. Contract DAHC-15-72-C-0235. 240p. (SRD-73-139). NTIS $6.00.

The report defines, investigates, and experimentally evaluates the key elements of a representative cryogenic turborefrigerator subsystem suitable for providing reliable long-lived cryogenic refrigeration for a superconductive ship propulsion system. (GRA)

28382 (AD-775573) SUPERCONDUCTING WINDINGS. Annual Report No. 1, 1 May-3 December 1973. Walker, M. S.; Murphy, J. H. (Westinghouse Research Labs., Pittsburgh, Pa. (USA)). 26 Feb 1974. Contract N00014-73-C-0461. 31p. NTIS $3.25.

A schedule of the work accomplished under the program is presented with relevant discussion. Data and details are provided in appendices. The loss behavior of superconductors was examined for alternating fields superimposed upon fixed bias fields simulating the field conditions that might be observed in a machine. An extensive set of measurements on one practical superconductor has been completed, and measurements on several other conductors have been initiated. A parallel effort has been sustained to extend the theory of losses under these field conditions. (auth)

28383 (AED-CONF-74-089-043) INVESTIGATIONS ON SUPERCONDUCTING NIOBIUM RESONATORS OF HIGH CRITICAL FIELD STRENGTH. Martens, H.; Schnitzke, K.; Hillenbrand, B.; Diepers, H. (Siemens A. G., Erlangen (F. R. Germany). Forschungslaboratorium). 1974. 6p. (CONF-740451-5). (In German). INIS.

From spring meeting of the Arbeitskreis Festkoerperphysik of the Deutsche, Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

4 figs. With abstract.

High critical magnetic fields (TE_{011}: 159 mT, TM_{010}: 149 mT) could be obtained on x-band niobium resonators of varying starting material with the developed preparation methods. The resonators show no degradation after storage in air and the effect of various gases. At high field strengths a high temperature dependence of the critical field is repeatedly observed which indicates a limitation as a result of thermal instability. (GE)

28384 AMPLIFICATION BY INJECTION LOCKING OF A JOSEPHSON OSCILLATOR. Stancampiano, C.V.; Shapiro, S.

(Department of Electrical Engineering, University of Rochester, Rochester, New York 14627). Appl. Phys. Lett. 25: No. 5, 315-318 (1 Sept 1974).

Josephson oscillations near 9 GHz, produced by a point-contact junction mounted in a coaxial resonator and biased onto the cavity-induced step in its V-I curve, have been pulled in frequency and phase locked by a weak injected signal at a nearby frequency. The resulting output was at the signal frequency and had the narrow bandwidth and frequency stability of the input but the power level of the Josephson oscillations. Maximum gain of 51 dB was achieved for an input of 10^{-16} W. (auth)

28385 MAGNETOMETER FOR BIOLOGY AND MEDICINE. Gross, F. (Graz Univ. (Austria). Physikalisches Inst.). Umsch. Wiss. Tech.; 74: No. 13, 422-423(Jul 1974). (In German).

2 figs.; 4 refs.

A brief outline of the functioning and possible uses of a highly sensitive magnetometer based on the Josephson-effect of superconductivity, to measure extremely weak magnetic fields of the brain, skeleton muscles and of the heart, is given. (GE)

28386 NUMERICAL ANALYSIS OF VORTEX MOTION ON JOSEPHSON STRUCTURES. Nakajima, K.; Onodera, Y. (Research Institute of Electrical Communication, Tohoku University, Sendai, Japan): Nakamura, T.; Sato, R. J. Appl. Phys. 45: No. 9, 4095-4099 (Sept 1974).

The one-dimensional and two-dimensional sine-Gordon equations with dimensionless loss factors and unitless normalized bias are numerically calculated by computer. The results are presented for accelerations, velocities, collisions, coupled states, and two-dimensional propagation of solitons. (auth)

28387 SQUID TECHNIQUES. I. OBTAINING RELIABILITY IN POINT-CONTACT SQUID's. Buhrman, R.A.; Lukens, J.E.; Jackel, L.D.; Strait, S.F.; Warlaumont, J.M.; Webb, W.W. (School of Applied and Engineering Physics, Laboratory for Atomic and Solid State Physics, and the Materials Science Center, Cornell University, Ithaca, New York 14850). J. Appl. Phys. 45: No. 9, 4045-4048 (Sept 1974).

Stable and permanent niobium point-contact SQUID's have been fabricated by using oxidized niobium screws to form the point contact. The reliability of these devices is further ensured by a simple and versatile environmental shielding procedure. Over a period of five years there have been no failures of such SQUID's in our laboratory. The signal-to-noise performance of these SQUID's is quite good. (auth)

28388 SELF-HEATING HOTSPOTS IN SUPERCONDUCTING THIN-FILM MICROBRIDGES. Skocpol, W.J.; Beasley, M.R.; Tinkham, M. (Department of Physics and Division of Engineering and Applied Physics, Harvard University, Cambridge, Massachusetts 02138). J. Appl. Phys. 45: No. 9, 4054-4066 (Sept 1974).

Heating effects in both long and short superconducting thin-film microbridges are described and analyzed. Except near T_c at low voltages where superconducting quantum processes occur, all of our experimental dc I-V characteristics can be satisfactorily understood on the basis of a simple model of a localized normal hotspot maintained by Joule heating. We consider approximations appropriate to the cases of long bridges, short bridges, and bridges coupled to microwave radiation. The analysis leads to analytic expressions for the I-V characteristics which agree well with the experimental data. We show that the formation of such a hotspot is the dominant cause of the hysteresis observed in the I-V characteristics at low temperatures. We also show that the growth of such a hotspot imposes a high-voltage limit on the ac Josephson effect in these devices, and we compare the importance of such heating effects at high voltages in various types of superconducting weak links. (auth)

28389 EFFECT OF THE CURRENT-PHASE RELATIONSHIP ON THE I-V CHARACTERISTICS OF WEAK LINKS: NOISE EFFECTS. Falco, C.M. (Department of Physics, University of California, Irvine, California 92664). J. Appl. Phys. 45: No. 9, 4134-4135 (Sept 1974).

When noise effects are considered, the quasiparticle-pair interference current is shown to have an observable effect on the behavior of superconducting weak links even when the I-V characteristics calculated in the absence of noise are indistinguishable from those calculated without the interference current. (auth)

28390 TWO-DIMENSIONAL ARRAYS OF JOSEPHSON WEAK LINKS. Hansma, P.K.; Kirtley, J.R. (Department of Physics, University of California, Santa Barbara, California 93106). J. Appl. Phys. 45: No. 9, 4016-4024 (Sept 1974).

Two-dimensional arrays of Josephson weak links can be produced by evaporating metals in air or argon at reduced pressures onto insulating substrates. Below the superconducting transition temperature of the metal, these arrays enter a coherent state, capable of carrying a maximum supercurrent I_c, which has a temperature dependence similar to that for a single oxide barrier tunneling junction. The multiply connected nature of the arrays is most clearly demonstrated by a multiply periodic dependence of I_c on magnetic field applied perpendicular to the array. A simple model for the arrays with m current paths in parallel with n Josephson weak links in series is proposed. This model is used as a basis of a computer program which generates detailed I(V) curves for several assumed probability distributions of critical currents and two current-voltage characteristics for the individual weak links in the array. These computer-generated curves are compared with experiment. The model is also used to explain other aspects of the experimental observations, such as why the outermost current paths do not screen the applied magnetic field from inner paths. Some experimental results on the interaction of the arrays with electromagnetic radiation in the far infrared and microwave regions are included. (auth)

28391 SUPERCONDUCTING MICROWAVE CAVITIES AND JOSEPHSON JUNCTIONS. Smith, T.I. (Department of Physics and Electrical Engineering, University of Southern California, Los Angeles, California 90007). J. Appl. Phys. 45: No. 4, 1875-1879 (Apr 1974).

The possibility of using very-high-Q superconducting microwave cavities to obtain a strong coupling between the electromagnetic field and a Josephson junction has prompted a study of such systems. Expressions have been obtained describing the dc I-V characteristic of a junction biased so that the Josephson radiation frequency is near a resonance of the cavity in which it is located. The rf power coupled into an X-band (10 GHz) TE_{011} mode cavity from a weakly coupled junction is approximately $3\times10^{-13}\ I_0^2Q$ W, where I_0 is the critical current of the junction and Q is the cavity Q. When the coupling between the junction and cavity is large enough, the I-V characteristic becomes multiple valued and the power coupled to the cavity depends on the state of the system. The maximum power which can be coupled to the cavity is approximately $0.58I_0V_{dc}$, where V_{dc} is the voltage required to bias the junction to the resonant frequency of the cavity. (auth)

28392 QUANTUM DETECTION OF MICROWAVE ACOUSTIC PULSES. Martin, M.; Desmons, J.Y. (Laboratoire d'Ultrasons, Laboratoire d'Hydrodynamique Superfluide 59326 Centre Universitaire de Valenciennes, France). Appl. Phys. Lett. 25: No. 7, 421-423 (1 Oct 1974).

The effect of longitudinal phonons on a very wide Dayem bridge involving amplitude voltage steps $\Delta V = h\nu/2e$ of the detected echoes has been measured. The mechanism seems to be related to the motion of the vortices created by the dc bias current. (auth)

28393 EXPERIMENTAL OBSERVATION OF THE SWITCHING TRANSIENTS RESULTING FROM SINGLE FLUX QUANTUM TRANSITIONS IN SUPERCONDUCTING JOSEPHSON DEVICES. Guéret, P. (IBM Zurich Research Laboratory, 8803 Rüschlikon, Switzerland). Appl. Phys. Lett. 25: No. 7, 426-428 (1 Oct 1974).

We have made what we believe is the first experimental observation of the switching transients resulting from single flux quantum transitions in superconducting devices. For that purpose, we used "long" Josephson junctions or interferometers which exhibit overlapping vortex modes. By applying a magnetic field to such devices, vortex-mode transitions are induced. The resulting transients are detected by a small Josephson junction located nearby. The experimental results show unambiguously that the points where a signal is detected by the sense junction correspond to the vortex-mode boundaries of the device. These results have important implications for memory applications. (auth)

28394 A SINGLE FLUX QUANTUM JOSEPHSON JUNCTION MEMORY CELL. Zappe, H.H. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). Appl. Phys. Lett. 25: No. 7, 424-426 (1 Oct 1974).

Operation of a DRO single flux quantum Josephson junction memory cell is described. Writing and sensing is performed with coincident currents. The device acts as its own sense detector, switching to the gap voltage if a flux quantum was stored. Dense arrays not requiring standby power are potentially feasible. (auth)

28395 FAST-ACTING SUPERCONDUCTING SWITCH FOR PROTECTION OF SUPERCONDUCTING COILS IN THE PERSISTENT CURRENT MODE. Hagedorn, D.; Dullenkopf, P. (Ruhr-Univ., Bochum, Ger.). Cryogenics; 14: No. 8, 429-430(Aug 1974).

Superconducting switches which are normally used as shorting switches to operate superconducting coils in the persistent current mode are unsuitable for field energy removal from a coil in case of quenching by a parallel resistor because of the low resistance in the non-superconducting state. Moreover these switches have a long turn-off time compared with the characteristic transient time from the superconducting to normal state of high current density coils. The superconducting switch described in this paper permits switch off of current from 20 to 90 A within a few milliseconds with a normal resistance of about 200 Ω. The switch is activated inductively by a special winding configuration. (auth)

28396 CONSTRUCTION OF AN APPARATUS FOR THE MEASUREMENT OF THE SUPERCONDUCTING TRANSITION TEM-

PERATURE. Cervantes, J. J.; Chapela, V. M. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis., Supl. Fis. Apl.; 22: FA33-FA40(1973). (In Spanish).

The research on superconducting properties of materials requires an apparatus for the detection and temperature measurement of the superconducting transition. An apparatus which takes advantage of the Meissner effect was built to perform these experiments. The superconductor forms the core of an inductance in a resonant oscillator circuit; the transition is detected by a sharp change in the oscillation frequency taking place at the instant the inductance's core becomes superconducting. (auth)

28397 CONDENSATION AT VERY LOW PRESSURE. Mayer, E.; Brunet, Y. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis., Supl. Fis. Apl.; 22: FA41-FA54(1973). (In Spanish).

The evolution of the condensation surface temperature in a cryopump as a function of time was studied. The limiting value of the thickness of the condensed layer and the surface temperature depend, for a given gas, on the speed of the pump and on the area of the cold surface. The results are applied to the pumping of nitrogen on a liquid hydrogen cooled surface. (auth)

28398 RADIO-FREQUENCY SUPERCONDUCTING DETECTOR OF THE MAGNETIC FLUX: SQUID. Odehnal, M.; Petricek, V.; Tichy, R. (Ustav Jaderne Fyziky, Rez, Czech.). Cesk. Cas. Fys.; 24: No. 4, 356-363(1974). (In Czech).

A principle and a construction of a laboratory radiofrequency superconducting quantum interference device (SQUID) based on a direct-current Josephson effect is described. The heart of this device is a two-hole symmetric superconducting ring with a point contact. The bias and detected signal are controlled by electronics operating at 38 MHz. Device has a resolution of $\approx 6.10^{-12}$ T and its linear dynamic response with a closed flux-locked loop is up to ±100 quantum of the magnetic flux. (auth)

28399 MINIATURE CRYOSTAT FOR INVESTIGATING SUPERCONDUCTING PROPERTIES OF THIN METALLIC FILMS. Bulanova, L. V.; Zaporozhchenko, V. I.; Tarasov, V. P.; Pron'ko, V. G.; Rakhovskii, V. I. Meas. Tech. (USSR) (Engl. Transl.); 17: No. 1, 122-124(Jan 1974).

Translated from Izmer. Tekh.; 17: No. 1, 74-75(Jan 1974).

In view of the fact the heating of the films in superconducting laminated layers changes their properties and their exposure to the atmospheres leads to their oxidation, it is necessary to investigate them in the vacuum chambers used for their production. A cryostat designed for this purpose is described. (MHR)

28400 METHOD OF MANUFACTURE OF A SUPERCONDUCTING MATERIAL. Vitovskii, N. A.; Vikhlii, G. A.; Mashovets, T. V.; Ryvkin, S. M. US Patent 3,829,334. 13 Aug 1974. Priority Date 23 Jul 1971, USSR. 4p.

A method of manufacturing a superconducting material from a semiconducting material, such as InSb is described, consisting in that the semiconducting material is first cooled to a temperature which is not higher than 200°K. Then microscopic spots on the surface of the semiconducting material are subjected to pressures which are higher than the critical pressure for the semiconductor-metal structural phase transition; these pressures are then relieved. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 27626, 28778, 28783, and 28784.

28401 SOLUTION OF TIME DEPENDENT TRANSPORT EQUATION FOR THERMAL AND DELAYED NEUTRONS ACCORDING TO LAFORE–MILLOT–VAN KAMPEN–WIGNER–CASE METHOD. Zebitay'an, S. (Cekmece Nuclear Research and Training Center, Istanbul). Istanbul Univ. Fen Fak. Mecm., Seri C; 36: No. 1-4, 61-67(1971).

The problem treated concerns the solution of the time dependent transport equation for plane geometry, monoenergetic neutrons and isotropic scattering taking also into account the contribution of delayed neutrons into the neutron balance in a multiplying medium. Under some conditions, it is shown that it is possible to apply to this integro-differential equation the method of the separation of variables obtaining thus, three separate equations. Two of them are immediately integrated; but in order to solve the third which is dependent on the angular variable, it is necessary to apply the so-called CASE method which consists to find out the eigenfunctions of a singular equation. This equation has a spectrum with continuous and discrete parts. (auth)

28402 SOLUTION OF THE ONE-VELOCITY NEUTRON TRANSPORT EQUATION WITH DELAYED NEUTRONS. Ozemre, A. Y. (Istanbul Teknik Universitesi). Istanbul Univ. Fen Fak. Mecm., Seri C; 36: No. 1-4, 79-87(1971).

It was previously shown that the one-velocity time dependent neutron transport equation with a definite number of groups of delayed neutrons and isotropic scattering may be conveniently treated for the case of plane geometry by the means of what is now usually called the CASE's method. His solution for the angular part of the transport equation is exprimed by two families of eigenfunctions which are orthogonal to each other. The aim of the present article is to establish the closure and the completeness relations for the space of eigenfunctions concerning this solution. (auth)

28403 COMPARISON OF PROPERTIES OF SOME SINGLE- AND POLYCRYSTAL FILTERS FOR SLOW NEUTRONS. Vertebnyi, V. P.; Vlasov, M. F.; Kolotyi, V. V. (Kiev Nuclear Research Inst.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 3, 510-513 (Mar 1974). (In Russian).

The properties of Si and Ge monocrystals and of magnesium oxide polycrystals as slow-neutron filters were studied. The Si and Ge monocrystals had advantages over a number of other monocrystals used for such filters. (tr-auth)

28404 MONTE CARLO COMPARISON OF HYDROGEN COLD-NEUTRON SOURCES IN RADIAL AND TANGENTIAL BEAM-TUBE ARRANGEMENTS. Kalli, H. (Helsinki Univ. of Technology, Otaniemi (Finland). Dept. of Technical Physics). Nucl. Instrum. Methods; 118: No. 1, 61-71(1 Jun 1974).

A Monte Carol comparison of the moderating efficiency of various hydrogen cold-neutron sources in the radial and in the tangential beam-tube arrangements is described. In the calculations performed the length and the relative ortho–para abundance of cooled gaseous- and liquid-hydrogen moderator cylinders were varied. Maximum cold-neutron outputs were obtained by long moderator cylinders rich in parahydrogen in the tangential arrangement. It was found that with a suitable (non-optimal) choice of the moderator length the total cold-neutron output could be almost independent of the ortho–para mixture. (auth)

28405 NEUTRON DIFFRACTION INTENSITIES FROM VIBRATING DOUBLE-CRYSTAL SYSTEMS. Kenney, E. S.; Jefferies, J. D. E.; Jacobs, A. M. (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). Nucl. Instrum. Methods, 117: No. 2, 391-396(15 May 1974).

Thermal neutron diffraction has been studied using single and double quartz crystal systems vibrating in the compressional and flexure modes. A spectral shift has been noted for a vibrating crystal resulting in an increase in most probably diffracted neutron wavelength from 2.2 A to 2.9 A. Double crystal diffraction was found to yield a 95% survival of once diffracted neutrons in the second diffraction, but with a large beam angular divergence. Large amplitude flexure mode studies produced a 30% reduction in diffracted intensity and no measurable effect on beam divergence. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 28179, 28202, 28271, and 28551.

28406 (IAE-2305) METHODS FOR CALCULATION OF THE PROPERTIES OF A FOUR-NUCLEON SYSTEM WITH ACCOUNT OF DECAY CHANNELS. Baz, A. I.; Bragin, V. N.; Zhukov, M. V.; Kuz'min, I. I.; Ehfros, V. D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 20p. (In Russian). INIS.

Methods for the calculation of the properties of a four-nucleon system with consideration of the decay channels were examined. Equations were obtained for the calculation of the cross section of the p^3H, n^3He, and dd reactions arising from N-N interactions. The necessary matrix elements were calculated for partial states with S = 0 and L = 0. (tr-auth)

28407 (ITEF-957) CLUSTER APPROXIMATION "4 = 3 + 1" IN FOUR PARTICLE INTEGRAL EQUATIONS. Part 1. Narodetskii, I. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1972. 27p. (In Russian). INIS.

The first part of a study on the cluster approximation "4 = 3 + 1" in the integral equation for four particles is reported. Equations were examined which describe a discrete spectrum with quantum numbers S = T = 0, $h^P = O^+$. The kernels of these equations are expressed in terms of doublets of three-particle amplitudes. The equations indicate that in these amplitudes the contribution with full orbital momentum equal to zero dominates. For relating the equations to a system of one-dimensional integral equations, the Gilbert-Schmidt breakdown of intrinsic functions in a series of K harmonics, representing the kernel of the equations as the total of a double integral, is considered. The convergence of the Gilbert-Schmidt arrangement in the 4-particle problem showed that the first member of this series can be used in calculating the energy of the free state of alpha particles with a precision of about 1.5%. (tr-auth)

28408 (ORNL-tr-2798) "CASCADE" PROGRAM FOR MODELLING THE INTERACTION OF HIGH-ENERGY PHOTONS WITH ATOMIC NUCLEI. Emets, N. L.; Lubarski, G. Ya.; Ranyuk, Yu. N.; Sorokin, P. V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). [nd]. Translation of KHFTI-72-37. 13p. Dep. NTIS $4.00.

A computer program based on the Monte-Carlo method is described for the calculation of nuclear reactions occurring in complex nuclei under the influence of photons, nucleons, and π-mesons. The applicability of the program is limited to energies of ≈350 MeV, where the effects of π-meson generation during the interaction of pions and nucleons with the nucleus, and the effects of photoproduction of pairs of π-mesons on the nucleon are negligible. The calculations may be performed for an intranuclear nucleon distribution which is close to the charge distribution obtained in experiments of electron scattering on nuclei. A model of the nucleus with a homogeneous nucleon density was considered. The effects of photo absorption by the proton-neutron pair were taken into account according to the Levinger model, while absorption of the meson was considered on the basis of the model proposed by Brakner. The "cascade" program will be used to interpret the experimental data on high energy photonuclear reactions. (auth)

28409 ACCURACY OF THE DISTORTED–WAVE IMPULSE APPROXIMATION FOR BREAKUP REACTIONS IN A THREE-BODY MODEL. Young, S.K.; Redish, E.F. (University of Maryland, Department of Physics and Astronomy, College Park, Maryland 20742). Phys. Rev. C 10: No. 2, 498-519 (Aug 1974)

We have studied the reaction mechanisms of the (p, 2p) reaction on ^{4}He at energies of 65 and 100 MeV. The dynamics of the reaction is taken to be that of a three–particle system, the ^{4}He target being viewed as a proton bound to an inert triton. The particles interact via separable potentials chosen to fit bound state and scattering data of the two–particle subsystems. The protons are treated as identical bosons interacting with each other only in the relative S state, while the proton–triton potential is limited to relative L ≤ 2. The ^{4}He(p, 2p)^{3}H doubly differential cross section can be calculated exactly within this model by solving the Fadeev equations numerically using the method of deformed contours and Padé approximants. This can be compared with the distorted–wave impulse approximation (DWIA), calculated in this model by summing the appropriate subset of the multiple scattering series. This is done in momentum space and treats off–shell and finite range effects of the nucleon–nucleon T matrix as well as recoil effects exactly. We find that the DWIA is an adequate approximation at 100 MeV but is almost double the exact result at 65 MeV. Its use in the extraction of spectroscopic information below 100 MeV is therefore suspect. The shapes of the exact, distorted, and plane wave cross sections agree quite well with each other (and with the experimental shape), differing only in magnitude. (auth)

28410 PROTON–INDUCED DEUTERON BREAKUP AT 156 MeV. Didelez, J.P.; Goldman, I.D.; Hourany, E.; Nakamura, H.; Reide, F.; Yuasa, T. (Institut de Physique Nucléaire, Université de Paris–Sud, 91–Orsay, France). Phys. Rev. C 10: No. 2, 529-542 (Aug 1974).

The ^{2}H(p, 2p)n and ^{2}H(p, pn)p reactions have been investigated simultaneously using the 156 MeV synchrocyclotron beam. Outgoing nucleons were detected in coincidence by a NaI detector and a large liquid scintillation counter providing energy – time – of – flight – biparametric spectra from which the threefold differential cross sections $d^3\sigma/d\Omega_1 d\Omega_2 dE_1$ are deduced. For suitable angle pairs, the experimental spectra show either the characteristic quasi–free scattering peak, or the p– p or p–n final state interaction peaks. The experimental results are compared with various theoretical predictions; i.e., a simple spectator model calculation, off–energy–shell calculations including first and second order terms of a multiple scattering series, with or without the Coulomb interaction, and an extension to intermediate energy of a Amado type model. These theoretical calculations are briefly discussed. (auth)

28411 VECTOR AND TENSOR ANALYZING–POWER MEASUREMENTS FOR ^{3}H($\vec{d}$, d)^{3}H ELASTIC SCATTERING AT 11.4 AND 14.4 MeV. Donoghue, T.R. (Department of Physics, The Ohio State University, Columbus, Ohio 43210 and Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544); Ohlsen, G.G.; Jarmie, N.; Keaton, P.W. Jr. Phys. Rev. C 10: No. 2, 571-574 (Aug 1974).

Angular distributions of the vector and tensor analyzing powers A_y, A_{xz}, $1/2(A_{xx}-A_{yy})$, and A_{zz} have been measured at 11.4 and 14.4 MeV for d + ^{3}H elastic scattering. Mass identification techniques were used in detecting the scattered deuteron and the recoil triton at most angles. Measurements were made for the 33 to 140° center-of-mass angular range. The angular distributions of the various analyzing powers are very similar at both energies and additionally are similar to the d + ^{3}He analyzing-power data of König et al. at 11.5 MeV. (auth)

28412 ELASTIC PROTON SCATTERING FROM ^{3}He AND ^{4}He AND THE ^{4}He(p, d)^{3}He REACTION AT 85 MeV. Votta, L.G.; Roos, P.G.; Chant, N.S.; Woody, R. III (University of Maryland, College Park, Maryland 20742). Phys. Rev. C 10: No. 2, 520-528 (Aug 1974).

Differential cross sections for the elastic scattering of protons by ^{3}He and ^{4}He, and for the ^{4}He(p, d)^{3}He reaction were measured at an incident energy of 85 MeV. The elastic scattering cross sections have been compared with phenomenological optical model calculations which yield good fits to the experimental data, provided that a Majorana exchange term is included in the optical potential. The ^{4}He(p,d)^{3}He data show qualitative agreement with distorted–wave Born–approximation calculations. In addition the experimental data are compared to resonating group theory calculations; one channel calculations for the elastic scattering, and two channel calculations for the ^{4}He(p, d)^{3}He reaction. These resonating group calculations are in qualitative agreement, and generally reproduce the important features of the experimental data. (auth)

28413 POLARIZATION AND POLARIZATION TRANSFER IN THE REACTION ^{3}H(p, n)^{3}He AT 5.97 AND 9.9 MeV. Jarmer, J.J.; Haight, R.C.; Martin, J.C.; Simmons, J.E. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. C 10: No. 2, 494-497 (Aug 1974).

Angular distributions of the polarization transfer coefficients $K_x'(\theta)$, $K_z'(\theta)$, $K_y'(\theta)$, and the polarization $P(\theta)$ in the reaction ^{3}H(p, n)^{3}He have been measured for proton energies of 5.97 and 9.9 MeV. The measurements of polarization transfer were done with an incident polarized proton beam. The polarizations of the neutrons were measured with a liquid helium polarimeter. Comparisons are made with R–matrix calculations based on the levels of ^{4}He from the analysis of Werntz and Meyerhof. (auth)

28414 COMMENT ON PRECISE SINGLE–SCATTERING OPTICAL–POTENTIAL FIT TO 1 GeV p–^{4}He ELASTIC SCATTERING. Bassel, R.H.; Rosen, M. (Nuclear Science Division, Naval Research Laboratory, Washington, D.C. 20375). Phys. Rev. C 10: No. 2, 928-930 (Aug 1974).

The assertion in a recent letter by Saperstein of the failure of the Glauber scattering formalism in describing forward angle p–^{4}He elastic scattering is pointed out to be incorrect. The single scattering optical potential described there is at best no better than the Glauber formalism in describing elastic p–nucleus scattering at high energies. (auth)

28415 DISTORTION EFFECTS IN $\alpha + \alpha$ SYSTEM. Thompson, D.R.; Tang, Y.C.; Chwieroth, F.S. (School of Physics, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. C 10: No. 3, 987-990 (Sept 1974).

α–particle specific distortion effects in the $\alpha + \alpha$ system are examined by the addition of square–integrable distortion functions into the usual resonating–group formulation. The results indicate that such effects are not too important and can be neglected in calculations on other light nuclear systems. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 28415, 28448, 28452, 28556, 28565, and 28570.

28416 (EFI-20-73) η^0–MESON PHOTOPRODUCTION ON NUCLEI AND DETERMINATION OF η–N INTERACTION TOTAL CROSS SECTION. Abrahamyan, L. O.; Aganyants, A. O.; Adamyan, F. V. (Erevan Physics Inst. (USSR)). 1973. 12p. INIS.

The $\gamma A \rightarrow A'\eta$ reactions for the Be, C, Al, Cu, Ag, and Pb nuclei were studied at E_γ = 2 GeV and $|t| \approx 0.5$ (GeV/sec)^2. Using the Glauber–Margolis model, the total cross section of interaction of η^0 with the nucleon, $\sigma_{\eta N}$, was calculated. This result is sensitive to the ratio, R, of the differential cross section of photoproduction, η^0, to the neutron and proton. For R = 0.3–0.6, the experimental cross section $\sigma_{\eta N}$ agrees with the value 20 mb obtained from the quark model. (tr-auth)

28417 ENERGY DEPENDENCE OF TWO–NUCLEON TRANSFER REACTIONS ON LIGHT NUCLEI. Pignanelli, M.; Micheletti, S.; Iori, I.; Guazzoni, P.; Resmini, F.G. (Istituto di Scienze Fisiche dell'Università di Milano, Italy, and Istituto Nazionale di Fisica Nucleare, Sezione di Milano, Italy); Escudié, J.L. Phys. Rev. C 10: No. 2, 445-463 (Aug 1974).

The differential cross section has been measured at several incident proton energies between 20 and 45 MeV for the ^{14}N(p,^{3}He)^{12}C, ^{15}N(p, t)^{13}N, ^{15}N(p,^{3}He)^{13}C, and ^{18}O(p, t)^{16}O reactions. Data on the energy dependence of other transfer reactions on the same nuclei, i.e., ^{18}O(p, d)^{17}O, ^{14}N(p, α)^{11}C, and ^{18}O(p, α)^{15}N reactions, have also been obtained. These data are compared with distorted wave Born approximation (DWBA) predictions. The comparison indicates that the energy dependence of the cross sections is poorly explained by DWBA calculations based on single–step pickup which give a maximum in the cross section in the energy region where angular momentum matching conditions are achieved. The absence of corresponding maxima in the experimental excitation functions may indicate that other reaction mechanisms contribute substantially to the cross section. Theoretical approaches as successive pickup of the two nucleons and preequilibrium emission are also discussed. (auth)

28418 ISOSPIN MIXING IN ^{12}C STUDIED WITH THE ^{14}N(d, α)^{12}C REACTION AT E_d = 40 MeV. van der Woude, A.; Ockels, W.J.; Pasma, P.J.; Put, L.W. (Kernfysisch Versneller Instituut, University of Groningen, Groningen, The Netherlands). Phys. Rev. C 10: No. 2, 952-954 (Aug 1974).

The upper limit for the ratio of the cross sections for the isospin forbidden ^{14}N(d, α)^{12}C* (15.11 MeV, 1$^+$, T = 1) transition and the isospin allowed ^{14}N(d, α)^{12}C* (12.71 MeV, 1$^+$, T = 0) transition was found to be about 0.3% in the angular range from 6 to 10° (lab) and 0.5% at 40 and 50°. (auth)

28419 RESONANCE DEPOLARIZATION OF ^{12}B IMPLANTED IN METALLIC AND SEMICONDUCTOR HOSTS. McDonald, R.E.; McNab, T.K. (Nuclear Sciences Laboratory, Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). Phys. Rev. C 10: No. 2, 946-948 (Aug 1974).

Resonance depolarization measurements have been made on ^{12}B implanted in the semiconducting hosts silicon, germanium, and silicon carbide, and in the face–centered cubic metal hosts platinum, rhodium, palladium, gold, copper, aluminum, and silver. The Knight shifts of ^{12}B in the metallic hosts have been obtained by comparison of the resonant frequencies in silicon and metallic hosts. The measured Knight shifts $\Delta\mu/\mu$ are: [Pt; $-10(3) \times 10^{-5}$], [Rh; $4(4) \times 10^{-5}$], [Pd; $11(4) \times 10^{-5}$], [Au; $54(3) \times 10^{-6}$], [Cu; $60(6) \times 10^{-5}$], [Al; $66(9) \times 10^{-5}$], and [Ag; $67(3) \times 10^{-5}$]. The effective ^{12}B magnetic moment is determined to be $1.00282(2)\mu_N$ in Si, $1.00291(2)\mu_N$ in Ge, and $1.00287(2)\mu_N$ in SiC hosts. (auth)

28420 ANGULAR DISTRIBUTIONS FOR THE ^{9}Be(°Li, ^{7}Li)^{8}Be REACTION. Von Behren, P.L.; Norbeck, E.; Payne, G.L. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). Phys. Rev. C 10: No. 2, 550-555 (Aug 1974).

Angular distributions for the ^{9}Be(°Li, ^{7}Li)^{8}Be neutron–transfer reaction to form the lowest two states in ^{7}Li have been measured for laboratory energies of 5.5 and 6.5 MeV. Elastic scattering cross sections for ^{6}Li on ^{9}Be were measured at laboratory energies of 4.0 and 6.0 MeV in order to determine optical potentials for the theoretical analysis of the transfer cross section. Distorted–wave–Born–approximation calculations were found to be in reasonable agreement with the data, while Hauser–Feshbach calculations were not. This indicates that the reaction is primarily a direct process. (auth)

28421 (π^+,πN) KNOCKOUT REACTIONS ON ^{14}N FROM 50 TO 90 MeV. Zaider, M.; Alster, J.; Ashery, D.; Cochavi, S.; Moinester, M.A.; Yavin, A.I. (Department of Physics and Astronomy, Tel Aviv University, Ramat Aviv, Israel). Phys. Rev. C 10: No. 2, 938-940 (Aug 1974).

The cross sections for the knockout reactions $^{14}N(\pi^-, \pi^-n)^{13}N$ and $^{14}N(\pi^+, \pi^+n + \pi^0p)^{13}N$ were measured over the energy range of 50 to 90 MeV by an activation method. The ratio of the cross sections σ (π ^{14}N)/σ (π ^{12}C) at 70 and 90 MeV for both π^+ and π^- is in good agreement with the similar ratio from high energy (p, pn) reactions on the same targets. This is consistent with a quasifree pion–nucleus knockout picture. However, the ratio σ (π^- ^{14}N)/σ (π^+ ^{14}N), found to be about a third of the free pion–nucleon ratio, is in disagreement with the simple impulse approximation model. (auth)

28422 ^{6}Li(α, d)^{8}Be REACTION AND THE IMPORTANCE OF EXCHANGE PROCESSES. Greenfield, M.B.; Werby, M.F.; Philpott, R.J. (Department of Physics, Florida State University, Tallahassee, Florida 32306). Phys. Rev. C 10: No. 2, 564-570 (Aug 1974).

The ^{6}Li(α, d)^{8}Be$_{g.s.}$ reaction is studied in the expectation that exchange contributions will be enhanced relative to the more usual light particle stripping process. Angular distributions of deuterons were measured at bombarding energies of 20 and 24 MeV and are found to exhibit back–angle peaking characteristic of the exchange process. Calculations including only a direct stripping mechanism are not able to account for the back–angle peaking and disagree with the back–angle data by more than two orders of magnitude. A two–mode finite–range distorted–wave Born–approximation analysis including cluster exchange contributions accurately describes the observed backward peaking at both energies. The importance of exchange contributions is attributed to favorable kinematic conditions and large cluster amplitudes associated with the exchange process. (auth)

28423 TWO–BODY SHORT–RANGE CORRELATIONS AND COULOMB MATRIX ELEMENTS. Bertsch, G.F.; Shlomo, S. (Cyclotron Laboratory, Department of Physics, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 10: No. 2, 931-932 (Aug 1974).

Correlated Coulomb matrix elements are calculated by evaluating the appropriate G matrices G_{N+C} and G_N which correspond to $V_N + V_C$ (nuclear + Coulomb) and V_N potentials, respectively. Including the effect of the Pauli operator, we confirm the recent report by McCarthy and Walker that the effect of the two–body short–range correlations is small. (auth)

28424 2p–1h STRUCTURE OF ^{15}N FROM ^{14}C(p, p)^{14}C CROSS SECTION AND POLARIZATION MEASUREMENTS. Weller, H.R.; Blue, R.A. (Department of Physics, University of Florida, Gainesville, Florida 32601); Ramirez, J.J.; Bernstein, E.M.; Hiddleston, H.R.; Prior, R.M.; Darden, S.E.; Divadeenam, M. Phys. Rev. C 10: No. 2, 575-584 (Aug 1974).

The cross section for the ^{14}C(p, p)^{14}C reaction has been measured for proton energies from 4 to 11.5 MeV. The elastic proton polarization has been measured for proton energies from 3.2 to 5.7 MeV. The region between 3.2 and 7.5 MeV has been fitted using complex background phase shifts and 14 resonances. The parameters of E_{res}, Γ, Γ_p, and J^π were obtained for the 14 resonances. The data suggest several new candidates for T = 3/2 states in ^{15}N. A 2p–1h doorway state calculation shows reasonable agreement with most of the experimental results. (auth)

28425 UPPER LIMIT ON THE RADIATIVE WIDTH OF THE 9.64–MeV STATE OF ^{12}C. Chamberlin, D.; Bodansky, D.; Jacobs, W.W.; Oberg, D.L. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. C 10: No. 2, 909-911 (Aug 1974).

An experimental upper limit for the branching ratio, Γ_{rad}/Γ, for electromagnetic transitions from the 9.64–MeV state of ^{12}C has been established through a search for coincidences between inelastically scattered α particles and the associated ^{12}C ions. It is concluded, at a one standard deviation confidence level, that Γ_{rad} is less than 14 meV. (auth)

28426 DELAYED NEUTRONS IN THE DECAY OF ^{13}B. Alburger, D.E.; Goosman, D.R. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 10: No. 2, 935-937 (Aug 1974).

β–neutron time–of–flight techniques have been used to detect a third and previously unobserved neutron group in the decay of ^{13}B corresponding to a 0.022 $\pm$ 0.007% β–ray branch to the 9.90–MeV state of ^{13}C. The log ft of 4.95 $\pm$ 0.12 for this branch agrees with the log ft of 5.18 $\pm$ 0.14 for the analog ^{13}O $\rightarrow$ ^{13}N transition, and thus confirms a previous assignment of the 9.90–MeV ^{13}C state as the J^π = 3/2$^-$ analog of the 9.52–MeV state in ^{13}N. (auth)

28427 BETA DECAY OF ^{14}B. Alburger, D.E.; Goosman, D.R. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 10: No. 2, 912-918 (Aug 1974).

A target of BeO, enriched to 94% in ^{10}Be, has been bombarded with 31–MeV ^{6}Li ions, and delayed activities were measured by means of a fast beam chopper and a NaI (Tl) –plastic γ–β coincidence detecting system. γ rays corresponding to the known activities ^{11}Be, ^{12}B, ^{13}B, ^{16}N, ^{20}F, and ^{20}Na were observed in coincidence with β rays. In addition, the spectrum contained γ rays of 6.1 and 6.7 MeV decaying with $T_{1/2}$ = 16.1 $\pm$ 1.2 msec. The 6.1–MeV γ rays are in coincidence with β rays having E_{max} = 14.0 $\pm$ 0.7 MeV. This activity is assigned to ^{14}B produced in the ^{10}Be(^{6}Li,2p) ^{14}B reaction. Based on the observed γ–ray intensities the ^{14}B β–ray branches to ^{14}C states at 6.09 (1$^-$), 6.73 (3$^-$), and 7.34 (2$^-$) MeV are 81 $\pm$ 9%, $8.6^{+1.7}_{-4.0}$%, and < 11%, respectively, where an allowance of 5% has been made for a probable ground–state β–ray branch. It is deduced that ^{14}B has a spin–parity of J^π = 2$^-$ consistent with recent shell–model calculations. The experimental logft values for the β decay of ^{14}B are also in good agreement with theory. (auth)

28428 NUCLEAR SINGLE PION PRODUCTION NEAR THRESHOLD. Grossman, Z.; Lenz, F.; Locher, M.P. (Schweizerisches Institut für Nuklearforschung, CH 5234 Villigen, Switzerland). Ann. Phys. (N.Y.) 84: No. 1, 348-431 (15 May 1974).

The dynamics of the reaction ^{12}C(p,π^+)^{13}C(*) are investigated by discussing various reaction mechanisms. We show that the process is dominated by a two-nucleon mechanism with virtual N* formation. Contributions of NN intermediate states are small in comparison with NN* states. Higher-order multiple scatterings are discussed quantitatively. Individual cross sections are given for all ^{13}C final states of less than 10 MeV excitation energy (single particle states and collective states of complex structure). The calculations, which contain no free parameter, reproduce the experimentally observed selectivity of the reaction both with respect to relative normalization and shape of the angular distributions. The absolute cross section is close to experiment. Qualitative estimates give the correct order for the π^+/π^- ratio. (auth)

28429 SYSTEMATICS OF NUCLEAR SINGLE–PARTICLE STATES. Lodhi, M.A.K.; Waak, B.T. (Department of Physics, Texas Tech University, Lubbock, Texas 79409). Phys. Rev. Lett. 33: No. 7, 431-433 (12 Aug 1974).

Semiempirical model–independent formulas for single–particle energies of neutrons and protons in bound nuclei have been obtained as functions of nuclear parameters A and Z for given states specified by nlj. These formulas are almost as convenient as the harmonic oscillator energy formulas to use. The single–particle energies computed from these formulas have been compared with the experimental data and found in good agreement for occupied states. (auth)

28430 MULTINUCLEON REMOVAL IN THE ABSORPTION OF π^- AT REST AND AT 60 MeV. Ullrich, H.; Boschitz, E.T.; Engelhardt, H.D.; Lewis, C.W. (Institut für Experimentelle Kernphysik der Universität und des Kernforschungszentrums Karlsruhe, Karlsruhe, Germany). Phys. Rev. Lett. 33: No. 7, 433-436 (12 Aug 1974).

The intensities of γ rays from π^- absorption at rest on O, F, Mg, P, Ca, and Nb have been measured. The results are compared with those at 220 MeV, previously published. The α removal processes which have been reported to dominate at higher energies are not as pronounced in the present work. (auth)

28431 MEASUREMENT OF PION PHOTOPRODUCTION AT THRESHOLD ON ^{6}Li. Deutsch, J.; Favart, D.; Prieels, R.; Van Ostaeyen, B. (Institut de Physique Corpusculaire, Université Catholique de Louvain, B–1348 Louvain–la–Neuve, Belgium); Audit, G.; de Botton, N.; Faure, J. L.; Schuhl, C.; Tamas, G.; Tzara, C. Phys. Rev. Lett.; 33: No. 5, 316-319 (29 July 1974).

As a test of soft-pion theorems in nuclei, we measured near threshold the ratio of positive-pion photoproduction cross sections on ^{6}Li and on protons. If the total cross section of the reaction $\gamma + p \rightarrow \pi^+ + n$ is expressed as $\sigma_p = a_p q/k$, our result for the reaction $\gamma + {}^6Li \rightarrow \pi^+ + {}^6He_{g.s.}$ is $\sigma_{Li} = (0.073 \pm 0.002)a_p(q/k)[12.5/q/[\exp(12.5/q) - 1]]$, where q is the pion and k the photon c.m. momenta expressed in units of MeV/c. This result is considerably lower than the existing theoretical predictions. (auth)

28432 CLUSTER TRANSFER IN THE REACTION ^{11}B(α,n)^{14}N AT 12 TO 15 MeV. Ciocanel, A.; Corcalciuc, V.; Minzatu, I. (Inst. of Atomic Physics, Bucharest). Acta Phys. Austr.; 38: No. 1, 41-46(Aug 1973).

The angular distributions of the neutrons resulting from the alpha-bombardment of ^{11}B, measured at six incident energies using time-of-flight technique, are compared with the predications of the DWBA calculations. Assuming the transfer of a punctual-^{3}He, with different NLSJ transferred quantum numbers and appropriate optical model parameters, one proves a variety of theoretical curves with the shape of the experimental differential cross sections. One concludes that the simplified DI-theories, with a few exceptions, are not able to reproduce the experimental results, within this domain of energy and mass numbers. (auth)

28433 ^{12}C NUCLEUS AS A 3α SYSTEM WITH FORBIDDEN STATES. Smirnov, Yu. F.; Obukhovskii, I. T.; Neudachin, V. G.; Chuvil'skii, Yu. M.; Mukhtarova, M. I. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 19: No. 8, 285-286(20 Apr 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 8, 542-544(20 Apr 1974).

It is shown that the projection in the 3α system, of states forbidden by the Pauli principle in α-α pairs, is a sufficiently strong condition capable of preventing compression of the 3α system. (auth)

28434 SEARCH FOR HIGHLY EXCITED STATE OF THE ^{6}Li NUCLEUS. Duisebaev, A. D.; Ivanov, G. N.; Kebin, E. I.; Nechaev, Yu. I.; Solov'ev, Yu. V.; Sukharevskii, V. G.; Khaimin, V. A. (Inst. of Nuclear Physics, Alma-Ata, USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 8, 280-281(20 Apr 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 8, 531-534(20 Apr 1974).

The differential cross section of the reaction ^{9}Be(p,α)^{6}Li at E_p = 30 MeV was measured at an angle of 30° in the l.s. At an excitation energy of the ^{6}Li nucleus 14.0 MeV a relatively narrow state was observed, the width of which does not exceed several dozen keV, and the differential cross section of the excitation is 200 ± 60 μb/sr. (auth)

28435 TUNNELING BETWEEN TWO MOVING WELLS IN THE ADIABATIC APPROXIMATION. Deutchman, P.A.; Koelsch, D.C. (Department of Physics, University of Idaho, Moscow, Idaho 83843). Am. J. Phys. 42: No. 9, 743-759 (Sept 1974).

A solution in the adiabatic approximation of the Born–Oppenheimer type to Schrödinger's time–dependent equation in one dimension for a model three–body system is presented. The model problem for this system is a particle of mass m interacting with two attractive square wells that are receding at constant relative speed. Graphs of the time development of the probability distribution for the tunneling particle are presented for various initial conditions. The series of graphical solutions is useful as a visual aid in understanding the time development of a simplified three–body problem and the results of the model problem are used as a basis for understanding a nuclear reaction leading to three bodies in the final state. (auth)

28436 INFLUENCE OF MESON CHARGE EXCHANGE ON $\bar{p}$–ABSORPTION EVIDENCE FOR NEUTRON HALOS. Gerace, W.J.; Sternheim, M.M.; Walker, J.F. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. Lett. 33: No. 8, 508-511 (19 Aug 1974).

Pion charge exchange within the nucleus is shown to be an important effect in antiproton absorption experiments. It must be incorporated into any analysis which attempts to use absorption data to deduce the relative abundance of neutrons and protons at the annihilation site. (auth)

28437 STATISTICAL ANALYSIS OF THE ENERGY DEPENDENCE OF ^{12}C + ^{12}C CROSS SECTIONS. Shapira, D.; Stokstad, R.G.; Bromley, D.A. (Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. C 10: No. 3, 1063-1082 (Sept 1974).

A statistical analysis has been made of the narrow structure appearing in the excitation functions for ^{12}C + ^{12}C induced interactions for elastic scattering ($13.5 \leqslant E_{c.m.} \leqslant 37.5$ MeV), inelastic scattering ($20 \leqslant E_{c.m.} \leqslant 30$ MeV), and α particle production ($16 \leqslant E_{c.m.} \leqslant 21$ MeV). Average fluctuation widths, strengths and cross correlations predicted by the statistical models of nuclei and of nuclear reactions are compared with those obtained from the analysis of suitably reduced experimental data. Good agreement is found. The effects of gross structure, possible structure of intermediate width, and a small ratio of level width to spacing (Γ/D) on the analysis of the narrow structure were studied using synthetic excitation functions. Appropriate correction factors were obtained in this way for application to parameters extracted directly from the reduced data. The results of the studies with synthetic excitation functions support the validity of the present statistical analysis. Compound processes are found to contribute up to ~20% of the measured elastic scattering cross section at 90 ° c.m. New experimental results reported herein for ^{12}C(^{12}C, α)^{20}Ne reactions also suggest a large direct component, in contrast to earlier measurements on this reaction at lower energies. Hauser–Feshbach predictions of absolute compound cross sections show over–all good agreement with the average fluctuating cross sections deduced from the experimental data. It is concluded that the structure with widths ~0.3 MeV observed in the experimental excitation functions studied here is of statistical origin, and that the statistical model can also explain the occasional structural features with individual widths up to ~0.8 MeV. Apart from the gross structure associated with potential scattering, no evidence is found in the experimental data for structure requiring nonstatistical mechanisms for its explanation. (auth)

28438 PRODUCTION OF THE LIGHT ELEMENTS LITHIUM, BERYLLIUM, AND BORON BY PROTON–INDUCED SPALLATION OF ^{16}O. Laumer, H.; Austin, S.M.; Panggabean, L.M. (Cyclotron Laboratory and Physics Department, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 10: No. 3, 1045-1049 (Sept 1974).

Astrophysically important cross sections for the production of isotopes of lithium, beryllium, and boron in the proton–induced spallation of ^{16}O were measured for proton energies between 30 and 42 MeV. A time–of–flight method was used for mass identification. The astrophysical significance of the results is discussed. (auth)

28439 ISOSPIN–FORBIDDEN ALPHA DECAY OF THE 15.11–MeV STATE IN ^{12}C. Balamuth, D.P.; Zurmühle, R.W.; Tabor, S.L. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 10: No. 3, 975-986 (Sept 1974).

The branching ratio $\Gamma_\alpha/\Gamma_{total}$ has been measured for the 15.11–MeV 1^+ T = 1 state in ^{12}C. The result is $\Gamma_\alpha/\Gamma_{total}$ = (4.1 ± 0.9) %, in agreement with one previous measurement and in disagreement with another. The result was obtained by direct observation of the decay α particles from the reaction ^{13}C(^{3}He, α)^{12}C* → 3α. The data are consistent with a sequential decay via the first excited state of ^{8}Be. The 3α breakup of the 1^+ T = 0 state at E_x = 12.71 MeV was also studied. The data in both cases were fitted with a model in which the α–α final state interaction was treated as a simple Breit–Wigner resonance; order–of–emission interference effects were included. If the (isospin–forbidden) α width is interpreted as resulting from mixing between the two 1^+ states via a charge–dependent interaction, a large isospin–violating matrix element is involved. (auth)

28440 DIFFERENTIAL CROSS SECTIONS FOR CHARGED–PARTICLE EMISSION IN REACTIONS OF 58–MeV α PARTICLES WITH ^{12}C, ^{16}O, and ^{54}Fe: COMPARISON WITH THE EXCITON MODEL OF PRE–EQUILIBRIUM PARTICLE EMISSION. Bertrand, F.E.; Peelle, R.W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Kalbach–Cline, C. Phys. Rev. C 10: No. 3, 1028-1040 (Sept 1974).

Cross sections differential in energy and angle are presented for the proton, deuteron, triton, and α particles from reactions of 58-MeV α particles on C, O, and ^{54}Fe, and the angle–integrated differential spectra are compared with the predictions of an extended exciton model of pre-equilibrium reactions. The experimental results were obtained with a semiconductor telescope and cover the whole energy range above a few MeV. Except for oxygen, the results are given with uncertainties of 5–10%; for oxygen, relative intensities are valid at a given angle, but the absolute uncertainty is about 50%. The high-energy segment of the spectrum is highly anisotropic for all emitted particles, but for low energies the evaporation mechanism may be important for proton and perhaps α-particle emission. The inelastic α spectra from ^{54}Fe are more similar in shape to previous observations of the ^{54}Fe(p,xp) spectra than to the presently reported ^{12}C(α,xα) results. Comparisons are made between the data and the exciton model assuming an initial configuration of four particles. The model was extended to recognize that for reactions of incident α particles, emitted α particles and even deuteron, triton, and ^{3}He particles may contribute a significant fraction of the pre-equilibrium emission. The empirical internormalization factor for the relative intensity of various exit particles (mass number p_β) is found to be consistent with the ($p_{\beta!}$) value deduced previously from results with incident protons. Using matrix elements deduced from systematics, the predictions for ^{12}C yield qualitatively correct shapes with normalization for the various particle types correct to within a factor of 6. For ^{54}Fe, the magnitude and shape of the predicted integral spectra are good for secondary protons and deuterons, but the predicted spectra fall off far too rapidly at high energies for tritons and α particles. (auth)

28441 CORE M1 EFFECT AT A = 14. Peaslee, D.C. (Research School of Physical Science, The Australian National University, Canberra ACT.2600, Australia); Williamson, C.F. Phys. Rev. C 10: No. 3, 1229-1232 (Sept 1974).

A recent measurement of (e, e') scattering on ^{14}N supplies a new parameter, the q^2 dependence of M1 excitation to the 2.313 MeV state. An exhaustive analysis precludes a satisfactory fit with the $(1p)^{-2}$ configuration. Comparison with ^{6}Li suggests appreciable core effects at A = 14. Inclusion of the 15.1 MeV state in the ^{12}C core permits a generally acceptable fit, although with too great flexibility for uniqueness. (auth)

28442 NEUTRON STRENGTH OF THE 5.08–MeV $3/2^+$ STATE OF ^{17}O. Fortune, H.T. (Argonne National Laboratory, Argonne, Illinois 60439 and University of Pennsylvania, Philadelphia, Pennsylvania 19104); Vincent, C.M. Phys. Rev. C 10: No. 3, 1233-1235 (Sept 1974).

The data for the reaction ^{16}O(d, p)^{17}O to the unbound state at 5.08 MeV have been reanalyzed by using average sets of optical–model parameters and standard parameters for the transferred–particle well. Still, the neutron width extracted from the (d, p) data is only 2/3 of the measured width. (auth)

28443 DETERMINATION OF THE EFFECTIVE $^{12}C + ^{12}C$ POTENTIAL FROM THE SUB−COULOMB SINGLE−PARTICLE RESONANCES. Park, J.Y. (Physics Department, North Carolina State University, Raleigh, N. C. 27607); Scheid, W.; Greiner, W. Phys. Rev. C 10: No. 3, 967-974 (Sept 1974).

The sub−Coulomb resonances observed in the total reaction yield of the $^{12}C + ^{12}C$ system at 4.9, 5.6, and 6.2 MeV are explained as single−particle resonances. The "true" effective $^{12}C + ^{12}C$ potential is determined directly as the real potential which reproduce best the position and the spacing of the observed sub−Coulomb resonances. This potential is found from a parametrization of the two limiting adiabatic and sudden potentials. (auth)

28444 DIP IN THE $^{12}C(^{12}C, \alpha)^{20}Ne$ CROSS SECTION OF $E_{c.m.} = 19.2$ MeV. Greenwood, L.R. (Argonne National Laboratory, Argonne, Illinois 60439 and Northwestern University, Evanston, Illinois 60201); Fortune, H.T.; Segel, R.E.; Erskine, J.R. Phys. Rev. C 10: No. 3, 1211-1212 (Sept 1974).

In most of the excitation functions for the $^{12}C(^{12}C, \alpha)^{20}Ne$ reaction to levels of ^{20}Ne below $E_x = 17$ MeV, a pronounced minimum occurs at a center−of−mass (c.m.) bombarding energy of 19.2 MeV. The c.m. width is 400−500 keV. This structure is very likely due to the resonance reported by Van Bibber et al. in the $^{12}C(^{12}C, p)^{23}Na$ reaction at an energy of 19.3 MeV, with a width of ~500 keV. (auth)

28445 ON THE DECAY PROCESS $_{\Lambda}{}^{8}Li \rightarrow \pi^- + {}^4He + {}^4He$. Bohm, G.; Krecker, U. (Deutsche Akademie der Wissenschaften zu Berlin (German Democratic Republic)); Coremans-Bertrand, G.; Kielczewska, D.; Sacton, J. (Institut Interuniversitaire des Sciences Nucleaires, Brussels (Belgium)); Cantwell, T. (College of Technology, Kevin Street, Dublin, Ireland); Montwill, A.; Moriarty, P. (University Coll., Dublin (Ireland). Dept. of Physics); Davis, D. H. (University Coll., London (UK). Dept. of Physics); Tymieniecka, T. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej). Nucl. Phys., B; 74: No. 2, 237-247(25 May 1974).

The results of a study of the decay sequence $_{\Lambda}{}^{8}Li \rightarrow \pi^- + {}^8Be^* \rightarrow \pi^- + {}^4He + {}^4He$ are presented. The dominance of the transition to the 2.9 MeV level of ^8Be is confirmed. The total rate of transitions to the states of ^8Be at around 17 MeV is found to be 0.09 ± 0.02 of that to the 2.9 MeV level. This ratio, together with the angular correlations observed in decays involving these ~17 MeV levels, has been used to determine ϵ, the mixing angle for Λ hyperon coupling to the lowest states of ^7Li in the formation of ^8Li. The allowed ranges of values of the mixing angle ϵ are found to be 0.1 to 0.04 rad, and 0.9 to 1.2 rad. (auth)

28446 THE DECAY PROCESSES $_{\Lambda}{}^{8}Li \rightarrow \pi^- + {}^8Be^*$ (~17 MeV). Zieminska, D.; Dalitz, R. H. (Oxford Univ. (UK). Dept. of Theoretical Physics). Nucl. Phys., B; 74: No. 2, 248-268(25 May 1974).

The branching ratio is calculated for $_{\Lambda}{}^{8}Li$ decay to the (2^+) $^8Be^*$ states near 17 MeV using intermediate coupling wave functions for $_{\Lambda}{}^{8}Li$ and for the relevant ^8Be states. It is pointed out that this ratio is sensitive primarily to a mixing angle in the $_{\Lambda}{}^{8}Li$ wave function. Within one standard deviation, the data allow two ranges (+0.05 to +0.25 rad and +1.10 to +1.25 rad) for the value of ϵ. The further requirement that there also be acceptable agreement between the angular distribution expected for the subsequent $^8Be^*$(~17 MeV) → 2 ^4He decay and the data, shifts these allowed ranges for ϵ, to (+0.13 to 0.40) rad and (+0.9 to +1.2) rad. It is predicted that the dominant transition should be to $^8Be^*$(16.6 MeV), as is observed to be the case, rather than to $^8Be^*$(16.9 MeV). The interpretation of these values for ϵ is discussed in some detail and their implications for intermediate coupling shell-model calculations of Λ-hypernuclear wave functions are considered. (auth)

28447 PRODUCTION OF A MONOENERGETIC GAMMA FLUX USING A 2 MeV VAN DE GRAAFF ACCELERATOR. Sorriaux, A. P.; Rubio, A.; Boudet, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Nucl. Instrum. Methods; 118: No. 1, 213-216(1 Jun 1974). (In French).

Measurements were made in order to find high-energy gamma radiations from (p,γ) reactions on thick ^7Li, ^{27}Al and ^9Be targets using a 2 MeV Van de Graaff accelerator. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 28416, 28429, 28430, 28447, 28467, 28491, and 28504.

28448 (IKDA-74/7) AN SU(3) MODEL FOR S−D SHELL NUCLEI. Conze, M.; Feldmeier, H.; Manakos, P.; Wolff, T. (Technische Univ. Darmstadt (F. R. Germany). Inst. fuer Kernphysik). 1974. 15p. (In German). (AED-CONF-74-042-021; CONF-740322-(Absts)). INIS.

From conference on nuclear physics and high energy physics; Bochum, F. R. Germany (4 Mar 1974).

6 figs.

For light nuclei with mass numbers up to A = 40 there exists a special form of the shell model that is based on the SU(3) model of Elliott. This form emphasizes the collective rotational character and the cluster structure of the wave functions and allows an easy extraction of the spectroscopic factors for multiparticle transfer reactions from the wave functions. In the first part of the report this form of the shell model is described. Shell model calculations in the sd-shell configuration space using the effective interactions derived by Kuo and Brown give a good reproduction of the experimental data only for nuclei at the beginning of the sd shell. Nuclei with a low-lying second rotational band, i.e., nuclei with A ≈ 21, show a significant deviation of the calculated spectra from the experimental ones. In all cases the excited rotational band is too low, whereas the level spacing within the bands is correctly described. In the second part of the report it is shown that, by a modification of the effective residual interactions mentioned, the relative position of the bands can be changed without destroying their internal structure. (GE)

28449 $^{28}Si(n, n\gamma)$ PHOTON PRODUCTION CROSS SECTIONS FOR $E_\gamma = 1.78$ MeV, $5.0 \leq E_n \leq 9.5$ MeV. Dickens, J.K.; Morgan, G.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 10: No. 2, 958-960 (Aug 1974).

The excitation function for the production of the 1.78−MeV γ ray due to neutron interactions with ^{28}Si has been measured for incident neutron energies between 5 and 9.5 MeV with neutron energy resolution ~35 keV for $E_n = 5$ MeV to ~80 keV for $E_n = 9.5$ MeV. These data are compared with previously reported values and with the current ENDF/B evaluation. (auth)

28450 REEXAMINATION OF THE $^{24}Mg(d, p)^{25}Mg$ REACTION FOR $E_d = 10-15$ MeV. Schmick, T.A.; Kemper, K.W. (Physics Department, Florida State University, Tallahassee, Florida 32306); Bindal, P.K.; Koshel, R.D. Phys. Rev. C 10: No. 2, 556-563 (Aug 1974).

Complete angular distributions (18−165° c.m.) have been measured for the first six proton groups from the $^{24}Mg(d, p)^{25}Mg$ reaction and for the reaction $^{24}Mg(d, d_{0,1})^{24}Mg$ at $E_d = 14$ and 15 MeV to provide data to study multistep contributions to the transfer reactions with emphasis on the "j−forbidden" transition to the $7/2^+$ (1.611 MeV) state of ^{25}Mg. To assess compound nuclear contributions, excitation functions were taken with $E_d = 10-14$ MeV for the first six proton groups from the $^{24}Mg(d, p)^{25}Mg$ reaction. The excitation functions indicate significant amounts of nondirect structure for $E_d < 13$ MeV in all the reaction channels. Optical model, Hauser−Feshbach, standard distorted wave Born approximation (DWBA), and perturbative multistep calculations of the data have been performed. Comparison of the Hauser−Feshbach calculations with the 14 and 15 MeV data imply that compound contributions are negligible for all of the reaction channels except the "j−forbidden" channel. The multistep calculations give somewhat better agreement with the experimental results than do the DWBA calculations; however, the multistep calculations must be renormalized for each state and each bombarding energy, indicating an incomplete description of the data. (auth)

28451 MASS AND β DECAY OF THE NEW ISOTOPE ^{23}F: COMPLETION OF THE $T_z = +5/2$ SERIES OF 2s−1d−SHELL MASSES. Goosman, D.R.; Alburger, D.E. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 10: No. 2, 756-765 (Aug 1974).

The first reported measurements of the β decay, half−life, and mass of ^{23}F are presented. This isotope is the last of the eight $T_z = +5/2$ nuclei in the 2s−1d shell whose masses have been measured and compared to theory. ^{23}F was produced by the $^{10}Be(^{18}O, \alpha p)^{23}F$ reaction with 42−MeV ^{18}O ions and a target of BeO enriched to 94% in ^{10}Be, and was transferred pneumatically to a remotely located station where delayed γ rays and β rays were counted with Ge(Li) and NE 102 detectors, respectively. γ−ray energies (in keV) and relative intensities for the ^{23}Ne daughter transitions are 492.50 ± 0.57 (10.8 ± 2.8), 815.14 ± 0.53 (24.8 ± 4.7), 1016.62 ± 0.40 (20.1 ± 5.5), 1701.44 ± 0.15 (100 ± 4.7), 1822.25 ± 0.21 (47.4 ± 2.6), 1919.32 ± 0.54 (19.3 ± 2.5), 2129.24 ± 0.39 (68.0 ± 11.4), 2314.70 ± 0.53 (7.7 ± 2.7), 2414.34 ± 0.41 (14.8 ± 3.4), 2516.50 ± 0.51 (2.9 ± 1.0), 2734.48 ± 0.44 (11.9 ± 1.6), 3431.28 ± 0.35 (25.4 ± 1.6), and 3830.52 ± 0.36 (6.8 ± 0.9). The strongest observed β branch populates a previously unreported state in ^{23}Ne at 3831−keV excitation energy. The ^{23}Ne excitation energies (in keV) and relative β−branching intensities are 0 (<6250), 1016.64 ± 0.40 (<4.6), 1701.51 ± 0.15 (<3.8), 1822.33 ± 0.21 (14.4 ± 1.8), 2314.84 ± 0.53 (9.6 ± 2.0), 2516.65 ± 0.51 (4.7 ± 2.8), 3220.7 ± 0.7 (<1.2), 3431.55 ± 0.35 (21.9 ± 2.1), 3830.86 ± 0.36 (34.9 ± 5.3), 3836.9 ± 0.7 (<1.1), and 4435.99 ± 0.41 (14.5 ± 1.3). γ−ray branching ratios for several states

in ^{23}Ne are presented, and the half-life of ^{23}F is 2.23 ± 0.14 sec. By measuring the energy spectra of β rays coincident with each of the 1702-, 1822-, 2734-, and 3432-keV γ rays, the mass excess of ^{23}F has been determined to be +3360 ± 170 keV. This value is compared with the transverse relationship as well as the extreme single-particle shell-model predictions. Reported mass measurements for the complete T_z = +5/2 2s-1d-shell series are compared with the transverse relationship predictions, and a very systematic S-shaped deviation from the predictions is observed. The β-decay matrix elements coupling ^{23}F and ^{23}Ne are consistent with $J^\pi = 5/2^+$ for ^{23}F, as the extreme single-particle shell model would predict. (auth)

28452 DECAY PROPERTIES OF THE NEUTRON-RICH ISOTOPES, ^{11}Li AND $^{27-31}$Na. Roeckl, E.; Dittner, P.F.; Détraz, C.; Klapisch, R.; Thibault, C.; Rigaud, C. (Laboratoire René-Bernas du Centre de Spectrométrie Nucléaire et de Spectrométrie de Masse, 91406 Orsay, France). Phys. Rev. C 10: No. 3, 1181-1188 (Sept 1974).

Using an on-line mass spectrometer the decay properties of the $T_z \geq 5/2$ nuclei ^{11}Li, $^{27-31}$Na, ^{29,30}Mg were studied. The new isotope ^{30}Mg ($T_{1/2}$ = 1200 ± 500 msec) was identified by β counting. For the other isotopes the half-lives were remeasured by three independent methods with improved precision. By recording β-coincident γ spectra, the decays of $^{27-29}$Na were studied, leading to a 1^+ assignment for the ^{28}Na ground state. By simultaneous β and neutron multiscaling the delayed neutron emission probabilities P_n were determined for ^{11}Li and $^{27-31}$Na. The following half-lives (msec) and P_n values (%) were found: ^{11}Li(8.5/60.8), ^{27}Na (303/0.08), ^{28}Na (30.5/0.58), ^{29}Na (42.9/15.1), ^{30}Na (52.4/33.1), ^{31}Na (16.9/30). (auth)

28453 GENERATOR-COORDINATE SPECTRA OF 4n NUCLEI IN d-s SHELL. Khadkikar, S.B.; Kulkarni, D.R. (Physical Research Laboratory, Ahmedabad 380009, India). Phys. Rev. C 10: No. 3, 1189-1196 (Sept 1974).

The calculated energy spectra, quadrupole moments, and quadrupole transitions for 4n nuclei in d-s shell are reported. The framework of the generator coordinate method using angular momentum projected states from Hartree-Fock intrinsic states driven by an external quadrupole field is successfully employed. The agreement with experimental numbers is found to be quite satisfactory up to the middle of the d-s shell. The excited 0^+ levels and the electrical moments are satisfactorily explained. (auth)

28454 STATES IN ^{29}P VIA THE ^{32}S(p,α)^{29}P REACTION. Detorie, N.A.; Goss, J.D.; Rollefson, A.A.; Browne, C.P. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. C 10: No. 3, 991-996 (Sept 1974).

α particles from the ^{32}S(p,α) reaction were momentum analyzed with our 100-cm modified broad range magnetic spectrograph to determine accurate excitation energies in ^{29}P. Runs were taken at laboratory observation angles of 60, 90 and 120 ° using protons with nominal bombarding energies of 15 and 16 MeV. Five previously unreported levels in ^{29}P were identified at 4.6406 ± 0.0030, 5.0473 ± 0.0032, 5.5827 ± 0.0035, 5.7155 ± 0.0036, and 5.8259 ± 0.0048 MeV. Comparisons are made both with theoretical level calculations and the level structure of the conjugate nucleus ^{29}Si. A Breit-Wigner shape was used to fit the group at 4.3371 MeV; the width of this level was determined to be 48.7 ± 2.5 keV. (auth)

28455 MEAN LIVES IN ^{38}Cl. McCullen, J.D.; McIntyre, L.C. Jr. (Department of Physics, University of Arizona, Tucson, Arizona 85721). Phys. Rev. C 10: No. 3, 1213-1214 (Sept 1974).

Mean lives of eight states in ^{38}Cl have been measured using the ^{37}Cl(d,pγ)^{38}Cl reaction at 3 MeV incident energy. The Doppler-shift attenuation method was used. Results are (levels in keV, and mean lives in fs): 755 (325 ± 35), 1309 (510 ± 45), 1617 (1110^{+190}_{-130}), 1692 (1330^{+240}_{-190}), 1745 (640^{+180}_{-110}), 1785 (100 ± 15), 1981 (330 ± 25), 2743 (≤ 30). (auth)

28456 FINITE-RANGE DISTORTED-WAVE BORN-APPROXIMATION ANALYSIS OF STRONGLY OSCILLATING ANGULAR DISTRIBUTIONS OF HEAVY-ION REACTIONS. Werby, M.F.; Tobocman, W. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. C 10: No. 3, 1022-1027 (Sept 1974).

Angular distributions of the ^{32}S(^{16}O, ^{12}C)^{36}Ar reaction are characterized by strong oscillations for the ground state and to a lesser extent for the first excited state for E_{lab} = 45 MeV. We show that such a process can be described by a finite-range no recoil distorted-wave Born-approximation analysis using weakly absorbing, optical model potentials, and an α-particle cluster model description of the nuclei involved. Good fits to the data were obtained with this model. The influence of different choices of optical model potentials is examined. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 28123, 28416, 28429, 28430, 28436, 28440, 28491, 28495, 28553, and 28566.

28457 (AED-CONF-74-042-001) THE FOLDING MODEL FOR THE SCATTERING OF 104 MeV ALPHA PARTICLES. Rebel, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Zyklotron-laboratorium). 1974. 8p. (In German). (CONF-740322-(Absts.)). INIS.

From conference on nuclear physics and high energy physics; Bochum, F. R. Germany (4 Mar 1974).

11 figs.

At the Karlsruhe cyclotron differential cross sections have been measured for the elastic and inelastic scattering of 104-MeV alpha particles on ^{46}Ti, ^{48}Ti, ^{50}Ti, and ^{56}Fe. The interpretation of elastic scattering within the framework of the recently developed folding model leads to mass distributions of experimental rms radii that are in good agreement with results from electron scattering. The interaction model has been extended to inelastic scattering from collective levels in order to get direct information on the deformation of the mass distributions and on the intrinsic quadrupole moments. For a realistic description of the deformation of 1f-2p-shell nuclei the generalized collective model of Gneuss and Greiner was used for the analysis and was applied to ^{48}Ti and ^{56}Fe nuclei. (GE)

28458 PHOTONEUTRON CROSS SECTIONS OF ^{58}Ni AND ^{60}Ni. Fultz, S.C.; Alvarez, R.A.; Berman, B.L.; Meyer, P. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. C 10: No. 2, 608-619 (Aug 1974).

Photoneutron cross sections of ^{58}Ni and ^{60}Ni have been measured, using separated isotopes and nearly monoenergetic photons from in-flight annihilation of positrons. Both (γ, n) and (γ, 2n) cross sections have been obtained; the (γ, 3n) cross section for both isotopes was found to be essentially negligible up to the highest energy measured, 33.5 MeV. The peak cross section of 27 mb for ^{58}Ni occurs at 17.3 MeV, while for ^{60}Ni the peak cross section of 74 mb occurs at 16.3 MeV. The (γ, 2n) cross section of ^{58}Ni is small, never exceeding 1.5 mb, whereas in the case of ^{60}Ni the (γ, 2n) cross section rises to a peak value of just over 10 mb at approximately 24 MeV, where it constitutes over 30% of the total photoneutron cross section. In both nuclei the (γ, 2n) cross section appears essentially to vanish above 33 MeV, whereas the single-neutron cross sections of both appear to remain nearly constant from about 25 MeV to the maximum measured energy. Considerable structure appears in the total cross section of both nuclei throughout the giant-resonance region. Structure is also evident in the (γ, 2n) cross sections, particularly in the case of ^{60}Ni. Integrated total photoneutron cross sections up to 33.5 MeV were determined to be 286 MeV mb for ^{58}Ni and 704 MeV mb for ^{60}Ni. Our results are compared with those from previous photoneutron experiments, and, combined with measured photoproton cross sections, are used to test theoretical predictions based on shell-model calculations. (auth)

28459 HALF-LIVES OF ^{51}Cr, ^{48}Cr, AND ^{48}V. Tse, C.W.; Mundy, J.N.; McFall, W.D. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 10: No. 2, 838-839 (Aug 1974).

The half-lives of ^{51}Cr, ^{48}Cr, and ^{48}V have been determined by following the decay of the isotopes for six to ten half-lives. The half-lives were obtained by a least-squares weighted fit to the data. The half-life of ^{48}Cr($T_{1/2}$ = 21.56 ± 0.03 h) is considerably lower than previous measurements. (auth)

28460 DECAYS OF ^{58}Mn, ^{57}Mn, AND ^{56}Mn. Tirsell, K.G.; Multhauf, L.G. (Lawrence Livermore Laboratory, Livermore, California 94550); Raman, S. Phys. Rev. C 10: No. 2, 785-794 (Aug 1974).

We have measured with high accuracy the γ rays from 66-sec ^{58}Mn, 1.6-min ^{57}Mn, and 2.6-h ^{56}Mn. Thirty-seven γ rays were observed from ^{58}Mn decay, which were incorporated into a ^{58}Fe level scheme with 17 excited states below 4.9 MeV. Present evidence favors a 3^+ assignment for the ^{58}Mn ground state, but the β decays to low-lying 2^+ states are hindered. Additional weak γ transitions giving rise to new β-decay modes were observed from ^{57}Mn and ^{56}Mn decays. (auth)

28461 REACTION ^{42}Ca(p, t)^{40}Ca AND THE STRUCTURE OF ^{40}Ca. Debevec, P.T.; Garvey, G.T. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. C 10: No. 2, 680-696 (Aug 1974).

The reaction ^{42}Ca(p, t)^{40}Ca was studied at 41.7 MeV; angular distributions were obtained over the range from 10 to 60°. The lowest T = 1, 0^+ state was identified at 9.386 ± 0.012 MeV by comparison with the analog reaction ^{42}Ca(p, ^{3}He)^{40}K(1.639 MeV). The weak

population of these states is attributed to destructive interference between $d_{3/2}{}^2$ pickup from the two-particle component of ^{42}Ca and $f_{7/2}{}^2$ pickup from the four-particle two-hole component of ^{42}Ca. The excitation energy of these states cannot be accounted for by the $f_{7/2}-d_{3/2}$ effective interaction. Spectroscopic amplitudes for the Gerace-Green wave functions are calculated in a shell-model basis. Distorted-wave Born-approximation (DWBA) calculations for the lowest T = 0 and T = 1, 3$^-$, and 5$^-$ states are in qualitative agreement with the data. The DWBA calculations for the positive-parity states show greater pickup strength to the two-particle two-hole 0$^+$ and 2$^+$ states than to the four-particle four-hole 0$^+$ and 2$^+$ states. The experimental results are the opposite: the four-particle four-hole states are populated more strongly than the two-particle two-hole states. Although there are uncertainties in the DWBA calculations, it is suggested that the inability to account for the observed two-nucleon pickup demonstrates a deficiency in the Gerace-Green model. (auth)

28462 MEASUREMENT OF THE MAGNETIC MOMENT OF THE 4.49-MeV (5$^-$) STATE OF ^{40}Ca. Hensler, R.; Tape, J.W.; Matthews, J.; Benczer-Koller, N. (Department of Physics, Rutgers University, New Brunswick, New Jersey 08903); MacDonald, J.R. Phys. Rev. C 10: No. 2, 919-922 (Aug 1974).

The g factor of the 4.49-MeV (5$^-$) state of ^{40}Ca has been measured in a time integral, external magnetic field, perturbed angular correlation experiment. A value of g = 0.54 $\pm$ 0.10 was obtained. The angular rotation of the p-γ correlation for the 4.49-MeV (5$^-$) state was also measured for calcium nuclei implanted into a polarized iron foil. This measurement yields an average hyperfine magnetic field on calcium in iron which differs by a factor of 2 from the hyperfine field result obtained for ^{42}Ca (3.19-MeV, 6$^+$ state) implanted in iron. The discrepancy in observed fields indicates a multiplicity of lattice sites for this system. The theoretical estimate of the 5$^-$ state g factor is in agreement with the experimental value. (auth)

28463 γ-RAY TRANSITIONS IN ^{48}Cr AND ^{60}Zn. Kamermans, R.; Jongsma, H.W.; van der Spek, J.; Verheul, H. (Natuurkundig Laboratorium der Vrije Universiteit, Amsterdam, The Netherlands). Phys. Rev. C 10: No. 2, 620-623 (Aug 1974).

The level structure of the N = Z = even nuclei ^{48}Cr and ^{60}Zn was investigated. The levels were excited in the (^{3}He, n) reaction. By measuring direct γ radiation in coincidence with the outgoing neutrons information about the γ decay of the levels was obtained. (auth)

28464 STUDY OF THE REACTION ^{56}Fe(p, n)^{56}Co TO THE ANTIANALOG STATE. Fielding, H.W. (Department of Physics, University of Wyoming, Laramie, Wyoming 82070); Rickertsen, L.D.; Kunz, P.D.; Lind, D.A.; Zafiratos, C.D. Phys. Rev. Lett. 33: No. 4, 226-229 (22 July 1974).

The reaction ^{56}Fe(p,n)^{56}Co was studied at E_p=22.8 MeV for both the isobaric-analog-state (IAS) and antianalog-state (AAS) transitions. The difference in the observed angular distributions for these two L=0 transitions is not as striking as in (^{3}He,t) measurements. The strong cancelation expected for the AAS case was observed. The shapes of the angular distributions for both the IAS and AAS were improved by inclusion of a coherent two-step (p,d)(d,n) process. (auth)

28465 ISOSPIN-FORBIDDEN PROTON PARTIAL WIDTH IN ^{41}Sc AND SIMILAR A = 4n + 1 NUCLEI. Trainor, T.A.; Clegg, T.B.; Thompson, W.J. (University of North Carolina, Chapel Hill, North Carolina 27514). Phys. Rev. Lett. 33: No. 4, 229-232 (22 July 1974).

The lowest T=3/2 level in ^{41}Sc is observed as an isospin-forbidden resonance in ^{40}Ca(p,p$_0$)^{40}Ca at $E_{p,lab}$=4.978 MeV with proton partial width Γ_p=55$\pm$5 eV, which is about 50 times smaller than that previously assigned and 6 times smaller than theoretical width estimates. The trend of the proton reduced widths for T=3/2 isospin-forbidden resonances obtained from Γ_p values for target nuclei with $4 \leq Z \leq 20$ is shown to be consistent with a Z^2 dependence. (auth)

28466 DISCOVERY OF THE MISSING TWO-PARTICLE, TWO-HOLE 0$^+$ STATES IN ^{40}Ca. Seth, K.K.; Saha, A. (Northwestern University, Evanston, Illinois 60201); Benenson, W.; Lanford, W.A.; Nann, H.; Wildenthal, B.H. Phys. Rev. Lett. 33: No. 4, 233-236 (22 July 1974).

A good-resolution study of the reaction ^{42}Ca(p,t)^{40}Ca has revealed the existence of three new 0$^+$ states in ^{40}Ca at 7698, 8284, and 8438 keV excitation. Arguments are presented to show that these states are indeed the long sought-after 0$^+$, T=0 states with predominantly two particle, two-hole configurations. (auth)

28467 FERMI BETA DECAY, A > 40: THE MASSES OF ^{42}Sc, ^{46}V, ^{50}Mn, AND ^{54}Co. Hardy, J.C.; Ball, G.C.; Geiger, J.S.; Graham, R.L.; Macdonald, J.A.; Schmeing, H. (Atomic Energy of Canada Limited, Physics Division, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada K0J 1J0). Phys. Rev. Lett. 33: No. 5, 320-323 (29 July 1974).

The Q values for (^{3}He,t) reactions on ^{26}Mg, ^{34}S, ^{42}Ca, ^{46}Ti, ^{50}Cr, and ^{54}Fe have been measured relative to that for ^{27}Al(^{3}He,t)^{27}Si. The results lead to significant deviations from previously accepted values for the β-decay end-point energies of ^{42}Sc, ^{46}V, and ^{54}Co. The new ft values for these transitions now agree with other known superallowed transitions (A < 40); only the decay of ^{50}Mn remains anomalous. A limit is also set on the $Z^2\alpha^2$ radiative correction term. (auth)

28468 ELASTIC SCATTERING OF ALPHA PARTICLES BY ^{54}Fe AT 16 MeV. Yaramis, B. (Florida State Univ., Tallahassee). Istanbul Univ. Fen Fak. Mecm., Seri C; 36: No. 1-4, 141-148(1971).

The 16 MeV alpha particle beam obtained from the model EN Tandem Van de Graaff accelerator of the Florida State University was directed on the target, Fe^{54}, located at the center of an 18-inch diameter stainless-steel scattering chamber. Alpha particles scattered from the target were detected by 14 silicon surface barrier detectors mounted at 10° intervals. (auth)

28469 ENERGY-DEPENDENT EFFECTS IN THE ELASTIC SCATTERING OF ALPHA PARTICLES BY ^{58}Ni. Snyder, R. K. Minneapolis; Univ. of Minnesota (1974). 93p. University Microfilms Order No. 74-17,282.

Thesis (Ph. D.).

Differential cross sections for elastic alpha scattering by ^{58}Ni were measured at lab energies of 17.39, 20.40, 23.41, 26.41, 27.90, and 29.41 MeV. Data covered the angular range 15° (x 1.3°) to 175° (lab) with errors ranging from 1 to 3% for angles less than 90° and 3 to 10% for the backward hemisphere. A detailed description of a new system using position-sensitive detectors to obtain low-cross-section backward-angle data is included. The data were analyzed primarily by using a physically more realistic folded optical model, where the real central part of the alpha-nucleus interaction potential is obtained from the folding of a free nucleon-alpha potential (of Woods-Saxon shape) with the matter distribution of the ^{58}Ni nucleus. The free nucleon-alpha potential used was obtained from a global analysis of nucleon-alpha scattering data. This four-parameter model gave a good representation of the data with quality of fit decreasing at lower energies; this finding indicated that this model can adequately represent the marked changes in differential cross section with energy. In all cases, this model yielded fits which were comparable to those of the regular six-parameter model, while using two fewer adjustable parameters. Attempts to improve the representation of the potential by changing the shape of the matter distribution as well as the folded shape are included. In each case, a preference was shown for the folded model using a Woods-Saxon matter distribution. To determine the sensitivity of this model to matter parameters, constant χ^2/point contour plots were made in the matter plane for free variation of all other parameters. (Diss. Abstr. Int., B)

28470 POLARIZATION IN HEAVY-ION INELASTIC SCATTERING IN THE COULOMB-NUCLEAR INTERFERENCE REGION. Steadman, S.G.; Belote, T.A.; Goldstein, R.; Grodzins, L. (Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Cline, D.; de Voigt, M.J.A.; Videback, F. Phys. Rev. Lett. 33: No. 8, 499-502 (19 Aug 1974).

The polarization in the region of Coulomb-nuclear interference has been determined from the γ-ray correlation following excitation of the 856-keV 2$^+$ state in ^{56}Fe by 43-MeV ^{16}O ions. Elastic and inelastic scattering cross sections were also measured. Dramatic interference effects are observed in the transition amplitudes which can be reproduced by coupled-channel distorted-wave calculations. (auth)

28471 LIFETIMES OF THE $(f_{7/2})^3$ 15/2$^-$ STATES IN ^{51}V AND ^{43}Ca AND $(f_{7/2})^2$ 4$^+$ STATES IN ^{50}Ti AND ^{42}Ca VIA HEAVY-ION RECOIL-DISTANCE-METHOD MEASUREMENTS. Poletti, A.R. (State University of New York, Stony Brook, New York 11790 and Brookhaven National Laboratory, Upton, New York 11973); Brown, B.A.; Fossan, D.B.; Gorodetzky, P.; Kolata, J.J.; Olness, J.W.; Warburton, E.K. Phys. Rev. C 10: No. 3, 997-1000 (Sept 1974).

The recoil-distance method has been used in conjunction with heavy-ion reactions to measure the following mean lifetimes: τ = 8.0 $\pm$ 0.6 and 34.1 $\pm$ 1.5 psec for the $(f_{7/2})^3$ (15/2$^-$) states at 2700 keV in ^{51}V and at 2754 keV in ^{43}Ca, and τ = 7.7 $\pm$ 1.5 and 5.1 $\pm$ 0.4 psec for the $(f_{7/2})^2$ 4$^+$ states at 2676 keV in ^{50}Ti and at 2752 keV in ^{42}Ca, respectively. The resulting B(E2) strengths are interpreted in terms of effective charges for different model spaces. (auth)

28472 STRUCTURE OF ^{42}Ti FROM THE ^{40}Ca(^{3}He, n)^{42}Ti REACTION. Alford, W.P.; Lindgren, R.A.; Elmore, D.; Boyd, R.N. (Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627). Phys. Rev. C 10: No. 3, 1013-1021 (Sept 1974).

The structure of ^{42}Ti has been investigated using the ^{40}Ca(^{3}He, n)^{42}Ti reaction at a beam energy of 15 MeV. Comparisons between measured

angular distributions and distorted wave Born approximation (DWBA) calculations provide a number of new spin assignments. The DWBA analysis also provides an estimate of p state admixtures in the low-lying states of the $(f_{7/2})^2$ configuration. A comparison with the results of the $^{40}Ca(t, p)^{42}Ca$ reaction demonstrates the analog character of many levels in ^{42}Ti and ^{42}Ca up to about 6.5 MeV. Above 3 MeV, in states involving large p^2 or fp components in the wave function, transition strengths are comparable in both two-proton and two-neutron transfers. The states in ^{42}Ca generally occur at an excitation energy several hundred keV above the corresponding analog in ^{42}Ti, suggesting that the $f_{7/2}-p_{3/2}$ single particle splitting is slightly greater in ^{42}Ca. (auth)

28473 HALF-LIFE OF ^{41}Ca. Mabuchi, H.; Takahashi, H.; Nakamura, Y.; Notsu, K.; Hamaguchi, H. (Tokyo Univ.). J. Inorg. Nucl. Chem.; 36: No. 8, 1687-1688(Aug 1974).

The ^{40}Ca-enriched isotope was irradiated by pile neutrons. From the measurement of the activity ratio of two isotopes, ^{41}Ca and ^{45}Ca, produced at the same time, the half-life of ^{41}Ca was determined to be $(1.03 \pm 0.04) \times 10^5$ yr. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 28416, 28458, 28463, 28488, 28491, 28493, 28495, and 28566.

28474 TRANSFER VERSUS COMPOUND-NUCLEAR MECHANISM IN THE REACTION OF ^{12}C AND ^{11}B WITH ^{63}Cu AND ^{65}Cu. Williams, R.A.; Caretto, A.A. Jr. (Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). Phys. Rev. C 10: No. 2, 601-607 (Aug 1974).

Excitation functions and average projected ranges have been measured for the production of ^{66}Ga and ^{70}As from enriched ^{63}Cu and ^{65}Cu gargets with ^{11}B and ^{12}C projectiles of 10.5 MeV/amu. In addition, angular and range distributions were determined for the same products from ^{63}Cu and ^{65}Cu with 90 MeV ^{12}C ions. The results are compared with predictions based on the complete fusion compound nucleus mechanism and a quasielastic scattering model designed to represent transfer mechanisms. The results indicate that a number of the reactions must take place by more than one pathway. (auth)

28475 $^{87}Sr(t, p)$ REACTION AND THE TWO-PARTICLE-ONE-HOLE STATES OF ^{89}Sr. Cosman, E.; Slater, D. (Physics Department and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Casten, R.F.; Flynn, E.R.; Hansen, O. Phys. Rev. C 10: No. 2, 671-679 (Aug 1974).

The $^{87}Sr(t, p)^{89}Sr$ reaction has been studied at a bombarding energy of 20 MeV. The lowest states excited are basically of single-particle character, and the corresponding (t, p) differential cross sections contain a mixture of L values. A comparison of these cross sections to distorted-wave (DW) calculations yields qualitative information concerning configuration mixing in these states based both on the magnitudes as well as the shapes of the angular distributions. Analysis of the data is made partly by a comparison of DW calculations to the observed $^{87}Sr(t, p)$ differential cross section and partly by comparing experimental angular distributions of the $^{88}Sr(t, p)^{90}Sr$ reaction with those from $^{87}Sr(t, p)$. The higher-lying states observed in this experiment may be explained from the coupling of the $1g_{9/2}$ neutron hole to the multipole pairing phonons, represented by the low-lying states of ^{90}Sr. (auth)

28476 g FACTOR OF THE 632 keV $(5/2^+)$ LEVEL IN ^{77}As. Chopra, R.C.; Tandon, P.N. (Tata Institute of Fundamental Research, Bombay-400005, India). Phys. Rev. C 10: No. 2, 774-777 (Aug 1974).

The g factor of the 632 keV level ($T_{1/2} = 60 \pm 6$) psec in ^{77}As, populated in the 11.3 h β^- decay of ^{77}Ge, has been measured using the perturbed angular correlation technique. Large magnetic hyperfine fields present at arsenic in an iron host are used. Measurements were made using the 558-417 keV γ cascade through the 632 keV level. From the directional correlation of this cascade and the measured mean precession angle $\omega\tau$ for the 632 keV level, the g factor for this state has been calculated. The results obtained are $\omega\tau = 0.148 \pm 0.019$ and $g = +1.01 \pm 0.16$. The measured value of the g factor is compared with the predictions of various nuclear models applicable to nuclei in this region. (auth)

28477 PAIR EXCITATION IN ^{90}Zr. Day, R.H.; Parkinson, W.C. (Cyclotron Laboratory, Physics Department, The University of Michigan, Ann Arbor, Michigan 48105). Phys. Rev. C 10: No. 2, 941-942 (Aug 1974).

Results are presented for the two-proton transfer reaction $^{88}Sr(^3He, n)^{90}Zr$ at ^3He energies from 16.86 to 25.49 MeV. (auth)

28478 SEARCH FOR WEAK BETA AND GAMMA BRANCHES IN THE BETA DECAY OF ^{59}Fe. Mukerji, A.; Palazzo, D.; Ullman, J.D. (Department of Physics, Herbert H. Lehman College, City University of New York, Bronx, New York 10468). Phys. Rev. C 10: No. 2, 949-951 (Aug 1974).

The β decay of ^{59}Fe was studied by $\beta-\gamma$ and $\gamma-\gamma$ coincidence methods for direct evidence of β branches leading to higher excited states of ^{59}Co and to search for any transitions that had not yet been observed. Weak β branches were observed to the 1.481- and 1.434-MeV states of ^{59}Co, confirming earlier indirect evidence from γ-ray studies. No new γ transitions were observed, but some useful limits were set on branching ratios of suspected transitions. (auth)

28479 SPALLATION OF Cu BY 3.9-GeV ^{14}N IONS AND 3.9-GeV PROTONS. Cumming, J.B.; Haustein, P.E.; Stoenner, R.W. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973); Mausner, L.; Naumann, R.A. Phys. Rev. C 10: No. 2, 739-755 (Aug 1974).

Relative yields of 35 products extending from ^3H to ^{76}Br have been measured for the interaction of 3.9-GeV (278-MeV/amu) ^{14}N ions with copper. For purposes of comparison, cross sections of 54 nuclides produced by the irradiation of Cu with 3.9-GeV protons are also reported. Although the overall patterns of yields for ^{14}N ions and protons are qualitatively similar, there are significant differences. In the mass region $37 \leq A \leq 64$, the mass yield curve for ^{14}N ions decreases more rapidly with decreasing A than does the proton curve. No difference could be detected in the shapes of the charge dispersion curves. However, the data indicate a small shift (<0.1 Z unit) favoring neutron-deficient products near the target in the case of ^{14}N ions. The mass yield curves appear to have similar shapes from $A \simeq 40$ down to $A \simeq 24$, but formation of the still lighter products, ^7Be and particularly ^3H, is favored in the ^{14}N irradiation. An observed enhancement of products such as ^{62}Zn, ^{66}Ga, and ^{69}Ge is interpreted as arising largely from secondary reactions rather than from primary processes which add charge or mass from the ^{14}N to the target nuclei. Some discussion of results from this and other experiments with high-energy protons and heavy ions with complex nuclei is presented in terms of the concepts of limiting fragmentation and factorization. (auth)

28480 OBSERVED DIFFERENCES BETWEEN ARGON- AND KRYPTON-INDUCED REACTIONS LEADING TO THE SAME COMPOUND NUCLEI, ^{158}Er AND ^{156}Er. Gauvin, H.; LeBeyec, Y.; Lefort, M. (Chimie Nucléaire, Institut de Physique Nucléaire, B.P. No. 1, 91406 Orsay, France); Hahn, R.L. Phys. Rev. C 10: No. 2, 722-728 (Aug 1974).

Cross-bombardment experiments were carried out to produce the same compound nucleus ^{158}Er either in ($^{84}Kr + {}^{74}Ge$) or ($^{40}Ar + {}^{118}Sn$) reactions. Also the compound nucleus ^{156}Er was formed by using ^{72}Ge and ^{116}Sn targets. Evaporation residues ^{152}Er and ^{153}Er were detected, and excitation functions were constructed for (Kr, xn) and (Ar, xn) reactions, where x varies from 3 to 6. Some measurements were also made of (Ar, pxn) and (Kr, pxn) reactions leading to ^{152}Ho. A comparison of the absolute cross sections shows that complete fusion is more severly limited in the case of Kr ions than for Ar ions, at the same values of excitation energy and of maximum orbital angular momentum. It was deduced that the critical angular momentum is lower in the case of krypton bombardments, 52h instead of 76h for Ar at $E^* = 80$ MeV. Also, the measured excitation functions are narrower for (Kr, xn) than for (Ar, xn) reactions and the Kr thresholds are shifted to higher energies by some 15 MeV, as if more energy were necessary for emitting a given number of neutrons in the (Kr, xn) reactions than in the (Ar, xn) reactions. Such an effect cannot be explained in terms of the deexcitation of the compound nucleus. We conclude that in the case of krypton induced reactions on germanium, some particular aspects of the formation stage of the compound system may dissipate energy prior to attainment of full equilibrium. (auth)

28481 LEVELS OF ^{64}Ga VIA THE $^{64}Zn(p,n)$ AND $^{64}Zn(p,n\gamma)$ REACTIONS. Hansen, L.F.; Davis, J.C.; Dietrich, F.S.; Gregory, M.C.; Koopman, R.P. (Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. C 10: No. 3, 1111-1121 (Sept 1974).

The (p,n) and (p,nγ) reaction in ^{64}Zn has been studied from 8.0 up to 10.5 MeV in order to obtain the level structure of ^{64}Ga. The threshold of the (p,n) reaction obtained from an excitation function of the γ rays gave a Q value of -7.968 ± 0.020 MeV. The measured angular distribution of the neutrons and their cross sections at 10 and 10.5 MeV were compared with the predictions of a Hauser-Feshbach calculation. These results plus the measurements of the cascade γ rays among the levels and the lifetimes of some of them allowed the assignment of spins for some of the low excited levels in ^{64}Ga. (auth)

28482 TWO-PROTON TRANSFER REACTIONS INDUCED BY 56-MeV ^{16}O HEAVY-ION BEAM ON ^{64}Ni AND ^{76}Ge TARGET ISOTOPES. Lemaire, M.; Mermaz, M.C.; Sztark, H.; Cunsolo, A. (Département de Physique Nucléaire, Centre d'Etudes Nucleaires, Saclay,

BP 2, 91190, Gif–sur–Yvette, France). Phys. Rev. C 10: No. 3, 1103-1110 (Sept 1974).

An optical model and distorted–wave Born–approximation analysis of elastic scattering and one- and two-nucleon transfer angular distributions was employed phenomenologically to determine an optical model potential which reproduced simultaneously the elastic scattering and nucleon transfer data. This potential was found to have an imaginary part of smaller radius than the real one. The relatively weak absorption in the tail region of the optical potential was necessary for the oscillatory behavior at forward angles observed in the direct two–proton transfer angular distributions. The periodicity of these oscillations was 180 °/l_c, l_c being the grazing partial wave corresponding to the half–absorption radius of the strong absorption model. For the ^{76}Ge(^{16}O, ^{14}C)^{78}Se reaction, the anomalous behavior of the angular distribution of the first 2^+ excited level of ^{78}Se favored a two–step mechanism involving core excitation of the target and/or residual nucleus. (auth)

28483 INVESTIGATION OF THE STRUCTURE OF THE NUCLEAR SURFACE OF ZINC ISOTOPES. Gonchar, V. Yu.; Ivanov, G. N.; Yushkov, A. V. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 82-86(1974). (In Russian).

The nuclear diffraction of 38-MeV α particles on ^{64}Zn, ^{66}Zn, ^{68}Zn, and ^{70}Zn isotopes was studied. The measurements were made on the cyclotron of the Institute of Nuclear Physics of Kazakh SSR. The range of the angles was $\Theta = 15 \div 70°$ center-of-mass, the angular uncertainty was $\delta\Theta = \pm 0.4°$, and the energy resolution was 250 keV. The deviations from the Blair phase law were studied for the purpose of determining the sign of the nuclear deformation. All Zn isotopes showed a flattened form (sign $\beta_2 < 0$). The theoretical processing of the angular distribution of the elastic scattering was carried out by the method of parametric phase displacement. The angular distributions of the elastic scattering with excitation of the 2^+ and 3^- levels were analyzed within the framework of the strong absorption model. Values were obtained for the structural nuclear parameters for the quadrupole and octupole excitations. (tr-auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 28429, 28430, 28480, and 28514.

28484 (HMI-B-144) ANNUAL REPORT 1973 OF THE SECTION NUCLEAR AND RADIATION PHYSICS. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kern- und Strahlenphysik). Mar 1974. 157p. (In German). INIS.

With figs., tabs., and refs.

The abstracts of publications in the following fields: 1) theoretical physics, 2) nuclear reactions, 3) nuclear moments and internal fields, 4) atomic collision processes, 5) VICKSI-accelerator operation and development, data processing, 6) aerosol physics, as well as of papers of scientists and the coworkers, and the publications of the section Nuclear and Radiation Physics of the HMI in the year 1973 are presented. (GE)

28485 PROTON HOLE STATES OF ^{93,97,99}Nb. Bindal, P.K.; Youngblood, D.H.; Kozub, R.L. (Cyclotron Institute and Physics Department, Texas A & M University, College Station, Texas 77843). Phys. Rev. C 10: No. 2, 729-738 (Aug 1974).

The (d, ^{3}He) reactions on ^{96,98,100}Mo have been used at 40.7 MeV bombarding energy to populate proton hole states in the Nb isotopes. Ten groups of levels were observed in each nucleus and most of the expected strength in the $1g_{9/2}$, $2p_{1/2}$, $2p_{3/2}$, and $1f_{5/2}$ orbits was observed. Excitation energies and l values were obtained for nine new excited levels in ^{99}Nb. The Q value for the ^{100}Mo (d, ^{3}He) ^{99}Nb reaction was measured to be -5.639 ± 0.015 MeV, giving a ^{99}Nb mass excess of -82342 ± 15 keV. A hole–core coupling model is used to predict the levels of the Nb isotopes, and fair agreement with experiment is obtained. (auth)

28486 NEUTRON RESONANCE SPECTROSCOPY. XV. THE SEPARATED ISOTOPES OF Cd. Liou, H.I.; Hacken, G.; Rahn, F.; Rainwater, J.; Slagowitz, M.; Makofske, W. (Columbia University, New York, New York 10027). Phys. Rev. C 10: No. 2, 709-721 (Aug 1974).

The results of neutron time-of flight spectroscopy measurements for the separated Cd isotopes (110, 112, 114, 116) and for natural Cd, using the Nevis synchrocyclotron, are given. Transmission and self–indication measurements were made for a range of sample thicknesses for natural Cd, and for each of the above even-A separated isotopes. Resonance parameters, E_0 and (g) Γ_n^0, are given to ~ 10 keV for 110, 112, 114, 116, and to 2.3 keV for 111 and 113. The ^{111}Cd level assignment is from recent published measurements at the Oak Ridge electron linear accelerator using a sample enriched in ^{111}Cd. Levels in ^{113}Cd are those stronger ones seen in natural Cd, but not identified as due to other isotopes. We also obtained level parameters to ~ 10 keV for 181 levels which have no isotopic assignment. Many resonance Γ_γ and J values were obtained for 111 and 113, and a few Γ_γ values for even-A isotopes, with $\langle\Gamma_\gamma\rangle$ of each isotope being between 100 and 110 meV. The $10^4 S_0$ values are 0.50 ± 0.10, 0.38 ± 0.06, 0.53 ± 0.09, 0.43 ± 0.07, 0.70 ± 0.19, and 0.20 ± 0.06 for 110, 111, 112, 113, 114, and 116, respectively. Comparison of the $(g\Gamma_n^0)^{1/2}$ distributions with Porter–Thomas theory for 110, 112, 114, and 111 shows that many p levels are observed. An estimate of the level detection sensitivity and a Bayes's theorem analysis permit us to identify the detected p levels, and to determine the p strength function with a relatively small uncertainty. Few expected missing weak s levels for each of these isotopes were then added to their p level subtracted sets. Various statistical tests were applied, showing that the final s level selection choices for 110, 112, 114 and 111 are in good agreement with the orthogonal ensemble theory. The $10^4 S_0$ values for 110, 112, 114, and 111 are 2.8 ± 0.6, 2.5 ± 0.5, 3.2 ± 1.0, and 3.5 ± 0.7. The $\langle D\rangle$ values for s population are (174 ± 18) eV (110); (24.0 ± 1.5) eV (111); (137 ± 8) eV (112); (22.1 ± 3.8) eV (113); (183 ± 29) eV (114); and (264 ± 38) eV (116). (auth)

28487 LEVEL STRUCTURE OF ^{129}Ba FROM THE ^{130}Ba(d, t)^{129}Ba REACTION. Griffioen, R.D. (Department of Physics, Calvin College, Grand Rapids, Michigan 49506 and Florida State University, Tallahassee, Florida 32306); Sheline, R.K. Phys. Rev. C 10: No. 2, 624-631 (Aug 1974).

The level structure of ^{129}Ba has been investigated by means of the ^{130}Ba(d, t)^{129}Ba reaction using 16 MeV deuterons and a broad–range magnetic spectrograph. The Q value to the lowest observed state was found to be -4001 ± 15 keV. Energies and angular distributions have been measured for 13 levels below 1.0 MeV. The lowest observed state was found to have spin and parity of $1/2^+$ and a level 277 keV above this state with $l = 5$ is suggested to have $J^\pi = 11/2^-$. The clearly established absence of a lower-lying $7/2^-$ level, together with the well established systematics in the N = 75 Nd and Ce nuclei, demonstrates that the $11/2^-$ state is a member of the $\Omega = 9/2 - [514]$ band. (auth)

28488 STATISTICAL MODEL ANALYSIS FOR THE DEEXCITATION OF ^{117}Te AT $E^* = 71$ AND 107 MeV IN THE REACTIONS ^{14}N + ^{103}Rh AND ^{40}Ar + ^{77}Se. Galin, J.; Gatty, B.; Guerreau, D.; Schlotthauer–Voos, U.C.; Tarrago, X. (Laboratoire de Chimie Nucléaire, Institut de Physique Nucléaire, 91406 Orsay, France). Phys. Rev. C 10: No. 2, 638-650 (Aug 1974).

A detailed statistical model analysis is presented for the deexcitation of the compound nucleus ^{117}Te at excitation energies of 71 and 107 MeV being formed at both energies with large angular momenta by the reactions ^{14}N + ^{103}Rh and ^{40}Ar + ^{77}Se. The competition of charged particle (p, α), neutron, and γ emission is explicitly considered in the calculations for each decay step throughout the whole evaporation cascades. By this method the energy spectra of protons and α particles in the four reactions can be well reproduced with respect to their form, average kinetic energies, and absolute cross sections with a consistent set of the statistical model parameters. (auth)

28489 DECAY CHARACTERISTICS OF SOME NEUTRON-RICH LANTHANIDE NUCLIDES OBTAINED BY SISAK TECHNIQUE. Aronsson, P. O. (Chalmers Tekniska Hoegskola, Goteborg); Skarnemark, G.; Kvaale, E.; Skarestad, M. Inorg. Nucl. Chem. Lett.; 10: No. 9. 753-762(Sep 1974).

γ-γ coincidence measurements on short-lived, neutron-rich lanthanide nuclides were performed using a fast on-line chemical separation system. The results include the assignment of 11 γ-rays to ^{147}Ce and 6 to ^{148}Ce, decaying with mean half-lives of 56.4 ± 1.2 s and 48.1 ± 1.1 s, respectively. Several previously unknown γ-rays are reported for ^{144}La as well as for ^{148}Pr. Partial decay schemes are proposed for ^{144}La and ^{148}La, and the energy levels are discussed in terms of ground state rotational levels. (auth)

28490 PERTURBATIONS IN ANGULAR CORRELATIONS AS AN INTERFERENCE PHENOMENON. Leisi, H.J. (Laboratory for High Energy Physics, Swiss Federal Institute of Technology Zurich, c/o SIN, 5234 Villigen, Switzerland). Ann. Phys. (N.Y.) 84: No. 1, 39-79 (15 May 1974).

A complete derivation of the new formulation of the theory of perturbed angular correlations of time–independent interactions (H. J. Leisi, in "Angular Correlations in Nuclear Disintegration" (H. van Krugten and B. van Nooijen, Eds.), p. 375, Rotterdam University Press, Rotterdam, Holland, 1971.) is presented. Gamma–gamma directional correlation experiments are explicitly considered. The directional correlation functions for time–differential and time–integrated experiments are derived, including expressions for the general class of isotropic systems (powder sources). The formula for the interference amplitude which depends on the nuclear parameters and on the

eigenfunctions of the interaction Hamiltonian is derived for an arbitrary (time−independent) interaction. Properties of the interference terms that follow from symmetries of the interaction Hamiltonian are discussed. A general proof of the theorem concerning the interference of time reversed states is given. The new approach is demonstrated by considering three angular correlation problems explicitly, namely the coupling between the nuclear magnetic moment and a magnetic field, the (axially symmetric) quadrupole interaction in a crystal and the hyperfine interaction in a free atom in the Zeeman region. The results (some of which are well known) are derived with a particular emphasis on the close relationship between the angular correlation function and the level structure of the system in the intermediate state. The results are also relevant to a number of recent experiments which clearly demonstrate the quantum−mechanical interference nature of the angular correlation process. These experiments are briefly discussed. An extension of the present theory in order to include time−dependent perturbations is suggested. (auth)

28491 NEUTRON STRENGTH FUNCTIONS AND AVERAGE TOTAL CROSS SECTIONS II. THE BEHAVIOR OF THE AVERAGE CROSS SECTIONS AND THE S−WAVE SCATTERING LENGTHS. Pineo, W.F.E.; Divadeenam, M.; Bilpuch, E.G.; Seth, K.K.; Newson, H.W. (Triangle Universities Nuclear Laboratory and Duke University, Durham, North Carolina 27706). Ann. Phys. (N.Y.) 84: No. 1, 165-185 (15 May 1974).

Average neutron total cross sections have been measured in the keV region for natural samples of KCl, Sc, V, Mn, Co, Cu, Zn, As, Se, RbBr, CsI, Ce, Nd, Gd, Tb, Dy, Ho, and Hg, and for the separated isotopes ^{144,146,148}Nd and ^{149,152}Sm. The measurements were combined with those made earlier here (TUNL) and elsewhere to give a total data set which is comprised of the total cross sections for most of the natural elements and many separated isotopes. The cross sections were averaged over hundreds of keV and compared to various optical model calculations. The data are in fair agreement with spherical optical model calculations below A=140 and in poor agreement for heavier nuclei. The calculations using deformed potentials agree much better with the data, especially above A=140. The s−, p−, and d−wave strength functions, the s−(or R′) and p−wave phase shifts were extracted from the average cross sections of the nuclei mentioned above by the Duke average cross section method, but in this paper only $\langle\sigma_T\rangle$ and R′ are discussed (see Part III for strength functions). The values of R′, supplemented by those from other measurements, made both here and elsewhere, were compared to available optical model calculations which use deformed optical potentials. The calculations agree fairly well with the data. Measurements of R′ indicate that it rises much more rapidly at A=140 than would be predicted by the spherical optical model and confirm the rapid rise predicted by the deformed model. Similarly, a rise in R′ is evident around mass number A=50; however, enough experimental points are not available for a detailed comparison with theory. (auth)

28492 SUCCESSIVE PICKUP CONTRIBUTIONS TO THE ^{98}Mo(d, α)^{96}Nb REACTION. Coker, W.R.; Udagawa, T. (Center for Nuclear Studies, University of Texas, Austin, Texas 78712); Comfort, J.R. Phys. Rev. C 10: No. 3, 1130-1135 (Sept 1974).

The mechanism for (d, α) reactions is discussed, with special attention given to the ^{98}Mo(d, α)^{96}Nb reaction leading to the presumed $[(g_{9/2})_P\ (d_{5/2})_n^{-1}]$ multiplet in ^{96}Nb. The analysis relies on the coupled−reaction−channel approach for including contributions from the successive pickup processes (d, t) −(t, α) and (d, ^{3}He) −(^{3}He, α). An excellent description of both the shape and magnitude of the available data is possible with adjustment of only a single parameter, namely the effective strength D_0 of the direct plus nonorthogonality terms in the reaction amplitude. The effective direct term dominates for low−spin final states on unnatural parity, while the (d, t) −(t, α) term dominates for high−spin final states of natural parity. Extension of the results to the ^{92}Mo(d,α)^{90}Nb reaction is also discussed. (auth)

28493 (p, α) REACTION ON ^{93}Nb AND ^{89}Y. Vergnes, M.; Rotbard, G.; Kalifa, J.; Berrier−Ronsin, G. (Institut de Physique Nucléaire, 91−Orsay, France). Phys. Rev. C 10: No. 3, 1156-1165 (Sept 1974).

The (p, α) reaction has been studied at 15.2 MeV on ^{93}Nb and ^{89}Y and analyzed using distorted−wave Born−approximation and cluster form factors. The reaction is a direct triton pickup and compound nucleus effects are negligible. In the first case the transferred neutrons are the two extra core neutrons and the reaction behaves like a proton pickup. Positive parity states of ^{90}Zr are populated by the transfer of $g_{9/2}$ protons with strengths in good agreement with a simple model; new levels are excited corresponding to $p_{3/2}$ and $f_{5/2}$ proton holes. In the second case the neutrons are removed from the filled N = 50 shell; states corresponding to proton and neutron configurations in ^{86}Sr are excited with comparable strengths and it is difficult to get unambiguous spectroscopic informations. (auth)

28494 NUCLEAR LIFETIME OF STATES IN ^{94}Tc AND ^{96}Tc VIA THE PULSED−BEAM, DIRECT−TIMING TECHNIQUE. McDaniel, F.D.; Snyder, F.D. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). Phys. Rev. C 10: No. 3, 1124-1129 (Sept 1974).

The mean lifetimes of the 333 keV level in ^{94}Tc and the 119 and 315 keV levels in ^{96}Tc were measured by the pulsed−beam, direct−timing technique. The values obtained for the mean lifetimes are: τ (333 keV) = $2.2^{+0.3}_{-0.3}$ nsec, τ (119 keV = $37.0^{+0.6}_{-0.3}$ nsec, and τ (315 keV) = $2.9^{+0.5}_{-0.2}$ nsec. The transition strengths are in agreement with those for other transitions in this mass region. (auth)

28495 E2/M1 MULTIPOLE MIXING RATIOS OF $2' \rightarrow 2$ GAMMA TRANSITIONS IN EVEN−EVEN SPHERICAL NUCLEI. Krane, K.S. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. C 10: No. 3, 1197-1210 (Sept 1974).

A systematic survey is presented of E2/M1 mixing ratios of γ transitions between the $2^{+\prime}$ and 2^+ levels of even−even nuclei in the mass range $58 \leq A \leq 152$. Particular attention is given to the variations in the phase of the mixing ratios, which are deduced from the literature in a systematic manner. It is shown that the systematics of both magnitudes and phases of mixing ratios are explained quite well for a number of nuclei by a model proposed by Greiner, in which the magnitude of the mixing ratio is parametrized in terms of the deviation of the g factor of the first 2^+ state from the value Z/A. It is further shown that a semimicroscopic description, in terms of small admixtures of two−particle components to the phonon basis states, yields reasonable agreement with the observed phase variations and absolute magnitudes, even when only very few two−particle states are considered. (auth)

28496 ELASTIC AND INELASTIC SCATTERING OF 1.5−MeV NEUTRONS BY THE EVEN−A ISOTOPES OF ZIRCONIUM AND MOLYBDENUM. McDaniel, F.D.; Brandenberger, J.D.; Glasgow, G.P.; Leighton, H.G. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). Phys. Rev. C 10: No. 3, 1087-1098 (Sept 1974).

Differential elastic and inelastic cross sections were measured for 1.5 MeV neutrons scattered by the even−A isotopes of zirconium and molybdenum. The scattering samples were enriched isotopes of ^{90}Zr, ^{92}Zr, ^{94}Zr, ^{92}Mo, ^{94}Mo, ^{96}Mo, and ^{100}Mo. The cross sections were measured using a dynamically−biased neutron time−of−flight spectrometer. The differential cross sections have root−mean−square relative and normalization uncertainties of 2 to 3.5% and 7 to 7.5%, respectively, for elastic scattering, and 6 to 13% and 9 to 15%, respectively, for inelastic scattering. Isotopes with similar level structures have almost identical elastic angular distributions. The entire set of data was theoretically fitted using the optical−statistical model with resonance−width−fluctuation corrections. The calculated elastic differential cross section was assumed to be an incoherent sum of shape−elastic and compound−elastic scattering. At the minima in the angular distributions the cross sections were dominated by compound−elastic scattering. (auth)

28497 NEGATIVE−PARITY STATES IN ODD−MASS LANTHANUM ISOTOPES. Das Gupta, S.; de Takacsy, N. (Physics Department, McGill University, Montreal, Canada H3C 3G1). Phys. Rev. C 10: No. 3, 1220-1222 (Sept 1974).

A semimicroscopic calculation is done to obtain the negative parity states of odd mass lanthanum isotopes. In agreement with a recently published calculation we find that a positive deformation is needed to explain the experimental data. (auth)

28498 MASSES OF TECHNETIUM ISOTOPES. Comfort, J.R.; Finlay, R.W.; McKenna, C.M. (Physics Department, Ohio University, Athens, Ohio 45701); Debevec, P.T. Phys. Rev. C 10: No. 3, 1236-1238 (Sept 1974).

The masses of ^{96,97,98}Tc are determined by investigations of (p,n) and (^{3}He,d) reactions on molybdenum targets. The new values have a precision better than 10 keV. (auth)

28499 INVESTIGATION OF THE REORIENTATION EFFECT ON ^{122}Te, ^{124}Te, ^{126}Te, ^{128}Te, AND ^{130}Te. Barrette, J.; Barrette, M.; Haroutunian, R.; Lamoureux, G.; Monaro, S. (Laboratoire de Physique Nucléaire, Département de Physique, Université de Montréal, Montréal, Canada). Phys. Rev. C 10: No. 3, 1166-1171 (Sept 1974).

Measurements of the Coulomb excitation probabilities of the first 2^+ states in ^{122,124,126,128,130}Te have been made with ^{4}He and ^{16}O projectiles. The values of the reduced transition probabilities $B(E2;0^+ \rightarrow 2^+)$ and the static quadrupole moments of the first 2^+ states have been determined. The measurements yield for Q_{2^+} and $B(E2;0^+ \rightarrow 2^+)$: (-0.44 ± 0.10) eb or (-0.22 ± 0.10) eb and (0.666 ± 0.011) e^2b^2 for ^{122}Te; (-0.46 ± 0.10) eb or (-0.11 ± 0.10) eb and (0.569 ± 0.011) e^2b^2 for ^{124}Te; (-0.28 ± 0.10) eb or (-0.20 ± 0.10) eb and (0.479 ± 0.011) e^2b^2 for ^{126}Te; (-0.33 ± 0.11) eb or (-0.26 ± 0.11) eb and (0.387 ± 0.011) e^2b^2 for ^{128}Te; (-0.14 ± 0.12) eb or (-0.09 ± 0.12) eb and (0.290 ± 0.011) e^2b^2 for ^{130}Te. (auth)

28500 IDENTIFICATION AND DECAY CHARACTERISTICS OF ^{137}I. Dikšić, M.; Yaffe, L. (Department of Chemistry, McGill

University, Montreal, Quebec, Canada); Sarantites, D.G. Phys. Rev. C 10: No. 3, 1172-1180 (Sept 1974).

The 83.6-min isomer of ^{132}I has been produced both by fission of uranium with medium-energy (30-85 MeV) protons and by the reaction ^{130}Te(α, pn)^{132}I, using tellurium enriched in mass 130. The isomeric transition is by a 98-keV γ ray (86%), the remainder decaying by β^- emission to levels in ^{132}Xe. Three new levels, viz 2650.1 $\pm$ 0.9, 2829.1 $\pm$ 0.9, and 2960.1 $\pm$ 1.2 keV in ^{132}Xe have been found. A decay scheme of ^{132}I^m is presented. (auth)

28501 14.8 MeV NEUTRON-INDUCED (n,p) CROSS-SECTIONS IN THE REGION OF THE PROTON MAGIC NUMBER 50. Mavaddat, T.; Rao, S. A.; Kuroda, P. K. (Univ. of Arkansas, Fayetteville). J. Inorg. Nucl. Chem.; 36: No. 5, 953-957(May 1974).

28502 SHORT-LIVED ISOTOPES OF LANTHANUM, CERIUM, AND PRASEODYMIUM STUDIED BY SISAK-TECHNIQUE. Aronsson, P. O. (Chalmers Tekniska Hoegskola, Goteborg); Sharnemark, G.; Skarestad, M. J. Inorg. Nucl. Chem.; 36: No. 8, 1689-1696(Aug 1974).

Short-lived, neutron-rich isotopes of the rare earth elements La, Ce, and Pr have been studied by the means of a continuous solvent extraction separation method. Half-lives, energies and relative intensities are reported for γ-rays attributed to 40 $\pm$ 3 sec ^{144}La, 20 $\pm$ 5 sec ^{145}La, 11 $\pm$ 1 sec ^{146}La, 58 $\pm$ 3 sec ^{147}Ce, 45 $\pm$ 5 sec ^{149}Ce and 9.1 $\pm$ 0.4 sec ^{150}Pr. Indirect evidence for the isolation of $\gtrsim$5 sec ^{149}Ce and 5 to 10 sec ^{150}Ce is also presented along with upper half-life limits of 5 sec for ^{147}La and ^{149}La. (auth)

28503 RECOIL-FREE FRACTION AND MAXIMUM RESONANCE CROSS SECTION OF ^{119m}Sn IN A MOESSBAUER $BaSnO_3$ SOURCE EMPLOYING A Si(Li) DETECTOR. Puri, R. K. Birmingham Univ. (UK). Dept. of Physics). Nucl. Instrum. Methods; 117: No. 2, 381-383(15 May 1974).

A high-resolution, silicon-lithium drifted detector was employed to detect the 23.88 keV Moessbauer gamma rays of ^{119m}Sn to correct for the non-resonant background of X-rays. An accurate value of 0.65 $\pm$ 0.01 was obtained for the recoil-free fraction of a Moessbauer $BaSnO_3$ source and the maximum resonance cross section of ^{119m}Sn was estimated equal to (1.31 $\pm$ 0.01) $\times$ 10^{-18} cm^2. (auth)

28504 INVESTIGATION OF GAMMA-RAY SPECTRA FROM THE INELASTIC SCATTERING OF REACTOR FAST NEUTRONS. Ahmed, M. R.; Shakarchi, Kh. I.; Al-Najjar, S.; Al-Amili, M. A. (Iraq Atomic Energy Commission, Baghdad. Nuclear Research Inst.); Govor, L. I.; Demidov, A. M. (I. V. Kurchatov Atomic Energy Institute, Moscow, USSR). Nucl. Instrum. Methods; 117: No. 2, 533-539(15 May 1974).

An installation for measurements of γ-ray spectra from the inelastic scattering of reactor fast neutrons on separate isotopes is described. Results are presented for Fe, Nb, Al and ^{106}Pd in the energy range from 0.1 to 3.5 MeV. (auth)

28505 A MEASUREMENT OF PRESSURE DEPENDENT PERTURBED ANGULAR CORRELATIONS IN GASEOUS SOURCES OF ^{127}Xe. Berek, U.; Kreisel, W.; Schneider, H.; Tierno, E. (Giessen Univ. (F. R. Germany). Abt. Grossgeraete). Phys. Lett., A; 48: No. 2, 79-80(3 Jun 1974).

The behavior of the perturbed angular correlation (PAC) in gaseous ^{127}Xe has been measured as a function of the pressure in the source. The results obtained do not agree with those previously reported. (auth)

Nuclear Properties and Reactions, 150 $\leq$ A $\leq$ 189

Refer also to abstracts 28436, 28489, 28491, 28495, and 28502.

28506 PROPOSED EXCITED BAND WITH REDUCED MOMENT OF INERTIA IN ^{156}Gd. Günther, C.; Hübel, H.; Rester, A.C. (Institut für Strahlen und Kernphysik, Universität Bonn, Germany); Blok, H.P.; Hulstman, L.; Kaptein, E.J.; Knöpfle, K.T.; Turek, P. Phys. Rev. C 10: No. 2, 943-945 (Aug 1974).

Excited states in ^{156}Gd were populated in the ^{158}Gd(p, t)^{156}Gd reaction with E_p = 18.0, 20.5, and 27.6 MeV. Our results do not confirm the existence of an excited rotational band with reduced moment of inertia compared to the ground state band which was suggested from a previous (p, t) experiment at E_p = 52 MeV. (auth)

28507 DECAY OF ^{177}Ta TO LEVELS IN ^{177}Hf. Jeltema, B.D.; Bernthal, F.M. (Departments of Chemistry and Physics and Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. C 10: No. 2, 778-784 (Aug 1974).

The locations of 13 energy levels have been deduced from γ-ray singles and γ-γ coincidence measurements on the EC-β^+ decay of ^{177}Ta to ^{177}Hf. Four energy levels and 14 γ rays associated with ^{177}Ta decay were unknown from the previous NaI(Tl) work. The logft values have been assigned to ^{177}Ta EC-β^+ decay, and multipolarities of several transitions have been determined with use of earlier conversion electron data. (auth)

28508 STUDIES OF ODD-A DEFORMED NUCLEI. I. ^{183}Re AND ^{181}Re. Singh, P.P. (Indiana University, Bloomington, Indiana 47401 and Naval Research Laboratory, Washington, D. C. 20375); Medsker, L.R.; G. T. Emery; Beach, L.A.; Gossett, C.R. Phys. Rev. C 10: No. 2, 656-670 (Aug 1974).

The levels of ^{183}Re and ^{181}Re have been studied through the (α,2nγ) and (α,4nγ) reactions with a ^{181}Ta target. Besides confirming and extending the levels of the 5/2$^+$ [402$\downarrow$] and 9/2$^-$ [514$\downarrow$] bands, two new members, 21/2$^-$ and 25/2$^-$, of the 1/2$^-$ [541$\downarrow$] band in ^{183}Re and existence and relative location of seven new members, 5/2$^-$, 9/2$^-$, 13/2$^-$, 17/2$^-$, 21/2$^-$, 25/2$^-$, and 29/2$^-$, of the 1/2$^-$ [541$\downarrow$] band in ^{181}Re are established. A few new lifetimes are measured and some side feeding to the levels of the above bands is established. (auth)

28509 NUCLEAR ORIENTATION STUDY OF THE DECAY OF ^{177}Lu^m. Krane, K.S. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Olsen, C.E.; Steyert, W.A. Phys. Rev. C 10: No. 2, 825-837 (Aug 1974).

Angular distributions of 37 γ rays were observed following the decays of 161-day ^{177}Lu^m and 6.8-day ^{177}Lu^g polarized at low temperatures in the ferromagnetic cubic Laves-phase compound $ZrFe_2$. The magnetic moment of the ^{177}Lu^m was deduced to be $|\mu|$ = 2.74$\pm$0.21 μ_N, in excellent agreement with the value μ = +2.59μ_N computed assuming the ^{177}Lu^m to be the three-quasiparticle state {7/2$^+$[404]$_p$, 9/2$^+$[624]$_n$, 7/2$^-$[514]$_n$}. The magnetic hyperfine fields of Lu, Ta, Sc, and Co in $ZrFe_2$ were deduced from the corresponding γ-ray anisotropies. Decays proceeding through the 1.1-sec ^{177m}Hf were observed to show characteristic relaxation times of $T_1 \simeq 6.7$ sec. The E2/M1 mixing ratios of numerous intraband transitions in ^{177}Lu and ^{177}Hf were deduced, and the corresponding $(g_K - g_R)Q_0$ values were computed. Several interband M2/E1 mixing ratios were deduced and were compared with calculations based on the Nilsson model including first-order Coriolis mixing. The 0-180° asymmetries of several ^{177}Lu transitions were observed in an effort to see if parity mixing effects might be present due to the particularly close-lying opposite parity states of ^{177}Lu; no effects were seen to the limit of 2×10^{-4}. (auth)

28510 APPARENT ABSENCE OF ELECTROMAGNETIC OR STRONG-INTERACTION TIME-REVERSAL VIOLATION IN THE DECAY OF ^{180}Hf^m. Krane, K.S. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Murdoch, B.T.; Steyert, W.A. Phys. Rev. C 10: No. 2, 840-852 (Aug 1974).

Time reversal (T) invariance in the nuclear interaction was investigated by observing the directional correlation of the strongly hindered 501-keV γ ray of ^{180}Hf with the subsequent 332- and 215-keV γ rays from a source of ^{180}Hf^m polarized at low temperatures. The asymmetry of the correlation was measured to be (2.8 $\pm$ 5.1) $\times$ 10^{-4}, corresponding to a phase angle between the 501-keV E3 and M2 multipoles given by sinη = 0.048 $\pm$ 0.087, consistent with the assumption of T invariance. Upper limits on the out-of-phase components of the E3 and M2 matrix elements were determined to be 3 $\times$ 10^{-6} and 1 $\times$ 10^{-5} Weisskopf units, respectively; these extremely small upper limits result from the use of a strongly hindered γ ray. In addition, based on these results, estimates of the magnitude of the T-odd potential were deduced, from which we conclude that the millistrong or electromagnetic interactions are unlikely to be a source of T violations. (auth)

28511 NUCLEAR-COULOMB INTERFERENCE IN INELASTIC SCATTERING OF α PARTICLES FROM ^{168}Er, ^{184}W, AND ^{186}W. Lee, I.Y.; Saladin, J.X.; Baktash, C.; Holden, J.E.; O'Brien, J. (Scaife Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. Lett. 33: No. 6, 383-386 (5 Aug 1974).

Excitation functions for the 0$^+$, 2$^+$, and 4$^+$ states of ^{168}Er, ^{184}W, and ^{186}W were measured at 140 ° and 173.5 ° with incident α-particle energies between 12.5 and 19 MeV. Strong destructive nuclear-Coulomb interference effects were observed. A coupled-channels code was developed, and the deformation parameters β_2^N and β_4^N of the optical potential were determined and are compared with those of the charge distribution, β_2^c and β_4^c. (auth)

28512 BETA DECAY OF ^{180}Lu. Ward, T.E. (Cyclotron Laboratory, Indiana University, Bloomington, Indiana 47401); D'Auria, J.M. Phys. Rev. C 10: No. 3, 1227-1228 (Sept 1974).

The allowed-unhindered β decay of ^{180}Lu strongly suggests that the 9/2$^-$[514]$_p$, 7/2$^-$[514]$_n$ Nilsson orbitals are involved in the transition. As a result of this proposed interpretation, the ground state Nilsson configuration of ^{180}Lu is most probably 9/2$^-$[514]$_p$, 1/2$^-$[510]$_n$ with K$^\pi$

= 5+, not 7/2+[404], 1/2−[510]$_n$ with $K^\pi = 3^-$ as previously suggested. (auth)

28513 ELECTRON-CAPTURE DECAY OF 2.4-HR ^{152}Dy. Devons, M. D. Sr.; Sugihara, T. T. (Texas A and M Univ., College Station). J. Inorg. Nucl. Chem.; 36: No. 8, 1697-1698 (Aug 1974).

A study of the radiations emitted in the electron-capture decay of 2.4 hr ^{152}Dy shows that only one level in ^{152}Tb, a 1+ level at 256.8 keV, is populated. Log ft for this transition is 4.3, and the γ-ray de-exciting the 1+ level is an E1 transition. (auth)

28514 ^{3}He-SCATTERING FROM THE STABLE EVEN Sm-ISOTOPES AT E_τ = 40.9 MeV. Palla, G.; Pegel, C. (Hamburg Univ. (F. R. Germany). 1. Inst. fuer Experimentalphysik). Z. Phys.; 268: No. 1, 51-55(May 1974).

3 figs.; 2 tabs.; 15 refs.

Differential cross sections of the scattering of ^{3}He particles from ^{144,148,150,152,154}Sm nuclei were measured at E_τ = 40.9 MeV. The elastic scattering data were analyzed with the simple optical model. The ambiguities of the real central potential and some trends depending on the target mass in the optical potential parameters are discussed. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 28122, 28416, 28429, 28436, and 28491.

28515 EVIDENCE FOR (α, ^{5}He) REACTIONS IN THE INTERACTION OF HIGH-ENERGY α PARTICLES WITH ^{208}Pb. Pirart, C.; Bosman, M.; Leleux, P.; Macq, P.C.; Meulders, J.P. (Institut de Physique Corpusculaire, Université de Louvain, B−1348 Louvain−la−Neuve, Belgium). Phys. Rev. C 10: No. 2, 651-655 (Aug 1974).

α−neutron coincidence measurements performed on the ^{208}Pb(α, αn) reaction at E_α = 66 MeV show clear evidence for short−lived ^{5}He production. The majority of α particles with energy between 40 and 51.5 MeV are assigned to the (α, ^{5}He) reaction channel. (auth)

28516 NEW $i_{13/2}$ ISOMER ^{207}Rn^m. Rezanka, I.; Ladenbauer−Bellis, I.M.; Rasmussen, J.O. (Heavy Ion Accelerator Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. C 10: No. 2, 766-768 (Aug 1974).

The isomer ^{207}Rn^m was produced via the ^{197}Au(^{14}N, 4n) reaction and also by bombardment of natural Hg targets with ^{12}C ions. The isomer with a half−life of 181 ± 18 μs was found to decay by a cascade of two transitions 234 keV (M2) and 665.1 keV (E2) to the Rn ground state and was assigned as an $i_{13/2}$ shell−model state. (auth)

28517 α CONTINUOUS SPECTRA FOLLOWING K AND L AUTOIONIZATION DURING α DECAY OF ^{210}Po. Briand, J.P.; Chevallier, P.; Johnson, A.; Rozet, J.P.; Tavernier, M.; Touati, A. (Laboratoire Curie de l'Institut du Radium (Laboratoire associé au Centre National de la Recherche Scientifique), 75231 Paris Cedex 05, France). Phys. Rev. Lett. 33: No. 5, 266-268 (29 July 1974).

The α spectra emitted during K and L ionization following α decay of ^{210}Po are investigated in a coincidence experiment with x rays. We present the first observation of α continuous spectra emitted by radioactive samples. The probabilities of this phenomenon and the shape of the α spectra are discussed in the scope of an α collision with zero impact parameter. (auth)

28518 PRODUCTION OF ^{8}Be IN THE REACTION OF 126−MeV ^{12}C WITH ^{197}Au. Kozub, R.L.; Logan, D.; Miller, J.M.; Zebelman, A.M. (Department of Chemistry, Columbia University, New York, New York 10027). Phys. Rev. C 10: No. 3, 1246-1248 (Sept 1974).

The cross section for the production of ^{8}Be(g.s.) in the ^{12}C + ^{197}Au reaction at 126−MeV bombarding energy has been measured as 37 ± 8 mb. Thus, the total observed Be cross section is about 40 mb less than the Tl cross section for the same entrance channel, which suggests a substantial cross section for excited states of ^{8}Be. (auth)

28519 EVIDENCE FOR CHARGE EXCHANGE COUPLING IN ^{206}Pb(t, p)^{208}Pb. Bernstein, E.M.; Solomon, A.; Soga, M. (Western Michigan University, Kalamazoo, Michigan 49001); Armstrong, D.D. Phys. Rev. C 10: No. 3, 1239-1241 (Sept 1974).

Anomalies are observed in the excitation function of the ^{206}Pb(t, p)^{208}Pb reaction measured at 169° lab from 9 to 16 MeV. In addition to isospin forbidden analog resonances, anomalous behavior is observed near the threshold for analogous (t, n) reaction. These results as well as previously reported data for other reactions are consistent with the interpretation of this latter anomaly as arising from charge exchange coupling. (auth)

28520 RADIATIVE PION CAPTURE IN ^{209}Bi. Baer, H.W.; Bistirlich, J.A.; de Botton, N.; Cooper, S.; Crowe, K.M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Truöl, P.; Vergados, J.D. Phys. Rev. C 10: No. 3, 1140-1145 (Sept 1974).

The photon spectrum from stopped π^- absorption on ^{209}Bi was measured in the 50−150 MeV region with a high−resolution pair spectrometer. The total radiative branching ratio is 0.98 ± 0.10%. Transitions to the single−particle states of ^{209}Pb are weak, in agreement with calculations presented. Considerable transition strength is observed to states of ^{209}Pb at 6−16 MeV excitation with evidence for a narrow peak at 7.9 ± 0.4 MeV. Present evidence favors the interpretation of this peak as excitation of the analog of a $T_>$ giant quadrupole resonance expected at ≃26 MeV in ^{209}Bi. (auth)

28521 IMAGINARY OPTICAL POTENTIAL IN ^{206}Pb AND ITS COMPARISON TO ^{208}Pb. Lev, A.; Beres, W.P. (Wayne State University, Detroit, Michigan 48202). Phys. Rev. C 10: No. 3, 1223-1224 (Sept 1974).

The imaginary optical potential and absorption cross section for neutrons on ^{206}Pb are calculated within the particle−vibration model using intermediate structure. The results are compared to those for ^{208}Pb and are quite similar. The relationship to the nuclear spreading width is discussed. (auth)

28522 K^- ABSORPTION AND THE NEUTRON HALO OF Pb. Leon, M. (Los Alamos Scientific Lab., N. Mex. (USA)); Seki, R. (California State University, Northridge, California, USA). Nucl. Phys., B; 74: No. 1, 68-76(18 May 1974).

The amount of neutron halo in Pb implied by the recent K^- absorption experiment of Bugg et al., and a local potential parametrization of K^- X-ray data is determined. (auth)

28523 PARTICLE SPECTRA AND PARTICLE-VIBRATION COUPLING IN THE Pb REGION. Hamamoto, I. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Phys. Rep.; 10: No. 2, 63-105(Apr 1974).

A review is given of the present situation of understanding the structure of low-lying states in the nuclei around ^{208}Pb, especially working in the coupling between the vibrational degrees of freedom of the core and the degrees of freedom of particles. By taking mostly the octupole shape oscillation of ^{208}Pb as an example of vibrations, the particle-vibration coupling model is applied for understanding various aspects of the nuclear many-body problem. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 27618, 28526, and 28600.

28524 (JINR-E4-8116) SIMPLE CONFIGURATIONS IN THE CAPTURE STATE AND THE GENERAL PICTURE OF NUCLEAR STATE COMPLICATIONS. Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 21p. (CONF-740920-9). Dep. NTIS (US Sales Only) $4.25.

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

It is asserted that the effective nuclear forces and the methods of solving the many-body problem may serve as a basis for describing states of low, intermediate and high excitation energy. It is indicated that it is important to study nuclear structure complications with increasing excitation energy and fragmentation of single-particle and many-particle states. The foundations of the model for describing fragmentation which is based on the account of the quasiparticle-phonon interaction are presented. The results of calculations of fragmentation for the 631↓, 640↑, 620↑ and 600↑ one-quasiparticle states in ^{239}U are given. It is shown that the state strength is distributed over a wide energy interval, the distribution maximum is shifted down with respect to the single-particle energy. The degree of fragmentation is shown to depend strongly on the position of the single-particle level with respect to the Fermi level. A modified version of the model is given for treating highly excited states of the type of giant resonances and for studying their influence on the structure of states of intermediate excitation energy. The general assumptions of the approach based on the operator form of the wave function of highly excited states are presented, and the contribution of individual simple configurations to the neutron resonance wave functions is estimated. It is shown in which case the valence neutron model can be employed. The compound-state structure is discussed. (auth)

28525 PROTON STATES, ANOMALOUS CONVERSION, AND K−AUGER SPECTRA IN ^{241}Am FROM ^{241}Cm (ELECTRON CAPTURE)

AND ^{245}Bk (α) DECAYS. Porter, F.T.; Ahmad, I.; Freedman, M.S.; Milsted, J.; Friedman, A.M. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 10: No. 2, 803-824 (Aug 1974).

γ and conversion-electron spectra of mass-separated ^{241}Cm (32.8 day) samples were measured at high resolution with Ge(Li) detectors and a magnetic β-ray spectrometer; 28 γ rays and 75 conversion lines were identified. The multipolarities of most of the 28 transitions in ^{241}Am were deduced. Two-parameter γ-γ coincidences confirmed a level scheme incorporating all transitions in six rotational bands. The observed half-life of ^{241}Cm via the decay of the 471.8 keV γ ray was 32.8 ± 0.2 day. The α branching deduced from the measurements of L_2 and L_3 electron lines of the 145.5 keV transition in ^{237}Pu was (1.0 ± 0.1) %. The α singles spectrum of ^{245}Bk (5 day) decay to ^{241}Am showed 12 α groups feeding the 3 lowest bands. On the basis of these measurements six single-particle states in ^{241}Am have been identified. The ground state of ^{241}Am is known to be 5/2-[523]. The following Nilsson band-head assignments have been made: (keV, $K\pi[Nn_zA]$): 205.9, 5/2 + [642]; 471.8, 3/2-[521]; 632.1, 1/2 + [400]; 652.1, 1/2-[530]; and 670.2 3/2 + [651]. The 266.0 keV E1 transition (3/2-[521] → 5/2 + [642]) was found to have the most highly anomalous conversion coefficients yet observed, with anomaly factors of 100-200, consistent with E1 penetration conversion parameter sets (λ_1, λ_2) = (18.5, 283) or (-19.3, -63); the exiting 205.9 keV E1 transition (5/2 + [642] → 5/2-[532]) shows normal E1 conversion. The 471.8 keV M1 + ~ 7% E2 transition (3/2-[521] → 5/2-[532]) also shows anomalous (factor of 3) conversion, with an M1 penetration parameter ~5.5. There is some indication of anomalously low K conversion for transitions near K threshold. Observed P_1 conversion line intensities are about twice the theoretical P_1 conversion coefficient predictions. Seven KLL- and two KLM-Auger electron lines were observed and the K-shell fluorescent yield was deduced as (96.5 ± 0.4) %. (auth)

28526 STRUCTURE OF THE FISSION TRANSITION NUCLEUS ^{227}Ra. Groening, H.R.; Loveland, W.D. (Department of Chemistry, Oregon State University, Corvallis, Oregon 97331). Phys. Rev. C 10: No. 2, 697-708 (Aug 1974).

The height of the fission barrier and the character of the low-lying single particle levels have been determined for the fission transition nucleus ^{227}Ra by fitting the energy variation of the previously reported fission cross section and fragment angular distributions in the neutron energy range $3.6 < E_n < 4.1$ MeV using a Hauser-Feshbach formalism. The best fit to the experimental data gave a fission barrier height $E_f = 8.2 \pm 0.1$ MeV and a single-particle state sequence at the barrier of 3/2, 1/2, 5/2, 1/2, which agrees very well with the theoretical predictions of Nix and Möller. An extension of the calculations to higher neutron energies ($4.7 < E_n < 9.0$) allowed deduction of K_0^2 and the transition nucleus level density as a function of excitation energy. A discontinuity in the K_0^2 values suggests a value of the pairing gap parameter ($2\Delta_f$ = 2.7 MeV) that is considerably larger than the corresponding one at the equilibrium deformation ($2\Delta_0$ = 1.7 MeV). The transition nucleus and residual nucleus level densities were compared with theoretical calculations and support the view that a collective rotational and vibrational enhancement of the intrinsic nuclear level density is necessary to account for the experimental data. (auth)

28527 SPECTRUM OF γ RAYS IN THE 8- TO 20-MeV RANGE FROM ^{252}Cf SPONTANEOUS FISSION. Dietrich, F.S.; Browne, J.C.; O'Connell, W.J.; Kay, M.J. (Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. C 10: No. 2, 795-802 (Aug 1974).

The spectrum of γ rays in the 8- to 20-MeV range has been measured for ^{252}Cf spontaneous fission using a 25.4 cm × 25.4 cm NaI crystal and time-of-flight separation of γ rays and neutrons. These data, obtained at three solid angles, are in disagreement with the recent result of Brooks and Reines that γ-ray events above 10 MeV in their experiment were due to two correlated γ rays detected simultaneously. A statistical calculation using the Hauser-Feshbach formalism was performed for the deexcitation of the highly excited fission fragments. The computed γ-ray spectrum in the energy range 8-17 MeV has the same shape as the measured spectrum but is lower than the measurement by a factor of 3 to 4. (auth)

28528 ISOMERIC GAMMA RAYS FROM ^{235}U(n, f) AND ^{239}Pu(n, f) FOR TIMES LESS THAN 1 μSEC AFTER FISSION. Sund, R.E.; Weber, H.; Verbinski, V.V. (Intelcom Rad Tech, San Diego, California 92138). Phys. Rev. C 10: No. 2, 853-870 (Aug 1974).

Measurements of the isomeric γ-ray energy spectra from the thermal-neutron fission of ^{235}U and ^{239}Pu were performed with a Ge (Li) detector for times between 20 nsec and ~1 μsec after fission. Eighty resolved γ-ray peaks with different energies and half-lives were observed; 37 of these γ-ray peaks had not been seen in previous delayed γ-ray measurements. The fission-fragment mass numbers for many of the γ rays were determined by comparison of the γ-ray energies and half-lives with the results of previous ^{252}Cf measurements. γ rays which decay in cascade from the same isomeric state were identified on the basis of mass numbers, γ-ray half-lives, and intensities. Isomeric γ-ray spectra from the spontaneous fission of ^{252}Cf were also measured in the present experiment; the analysis of a number of strong, resolved γ rays in these data indicated that the present results are consistent with previous ^{252}Cf results, within the sum of the systematic uncertainties of the two experiments. The total energy of the resolved peaks from this experiment, when integrated over all time, is 163 and 164 keV/fission for ^{235}U and ^{239}Pu, respectively. Roughly 40% of the total energy of the resolved peaks is from γ rays in the 1100- to 1340-keV region. Isomers in $^{134}_{52}Te_{82}$ and $^{136}_{54}Xe_{82}$ contribute most of these high-energy γ rays. In the 140- to 1340-keV energy range and 20- to 958-nsec time interval, the energy of the observed continuum of unresolved γ rays was ~20 and ~24% of the total delayed γ-ray energy for ^{235}U and ^{239}Pu, respectively. The energy of the resolved γ rays from this experiment for ^{235}U and ^{239}Pu is about twice that for the isomers from ^{252}Cf with the same range of half-lives, as observed from previous results. Most of the difference between ^{252}Cf and ^{235}U or ^{239}Pu is due to seven possible γ-ray cascades. (auth)

28529 NUCLEAR CHARGE DISTRIBUTION IN FISSION: FRACTIONAL INDEPENDENT YIELD OF ^{135}Xe FROM THERMAL-NEUTRON-INDUCED FISSION OF ^{245}Cm AND ^{249}Cf. Harbour, R.M. (Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, South Carolina 29801); Troutner, D.E.; MacMurdo, K.W. Phys. Rev. C 10: No. 2, 769-773 (Aug 1974).

Target foils containing ^{245}Cm or ^{249}Cf prepared by electrodeposition on high-purity aluminum foils were irradiated in a Savannah River Plant production reactor operated in a high flux mode. The ^{135}Xe activity was measured for each foil as a function of time-after-irradiation by counting the 249.6-keV γ-ray emission with a 45-cm^3 Ge(Li) detector. From these measurements, the fraction of the A = 135 mass chain produced directly as ^{135}Xe relative to the total production of ^{135}I plus ^{135}Xe was calculated. The measured fractional independent yield of ^{135}Xe from ^{245}Cm fission is 0.17 + 0.02, and from ^{249}Cf fission is 0.36 ± 0.03. These yields are compared with those of ^{135}Xe from thermal-neutron-induced fission of ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu. (auth)

28530 ACCURATE FISSION CROSS-SECTION OF ^{239}Pu FROM 0.005 eV TO 0.1 eV AND ITS REFERENCE VALUE AT 2200 m/s. Seruytter, A. J.; Becker, W. (Commission of the European Communities, Geel, Belgium). Ann. Nucl. Sci. Eng.; 1: No. 5, 311-322(May 1974).

A precise measurement of the fission cross section of ^{239}Pu was performed with a slow chopper at the Belgian BR2-reactor (energy range 0.005 to 0.1 eV). Simultaneous recordings of pulse-height and time-of-flight spectra of successively compared ^{239}Pu layers and standard elemental boron layers were made. The detection of the ^{10}B(n,α)^{7}Li and ^{239}Pu(n,f) reaction fragments is made with excellent pulse-height resolution in low geometry with a Au-Si surface barrier detector. The separation between the pile-up tail produced by the α-particles of ^{239}Pu and the fission fragment energy distribution was very good. The amount of ^{10}B in the elemental boron layers was determined by weighing in vacuum combined with careful chemical and isotopic analysis of witness foils. The relative amounts of ^{10}B were checked by neutron counting in the geometry of the experiment. The amounts of ^{239}Pu on the fission foils were determined from precise low geometry α counting and the knowledge of the isotopic composition and α-half-life values. The α activity was controlled before and after the measurements. The fission cross section was calculated in the energy range from 0.005 to 0.1 eV and its absolute value deduced at 2200 m/s was 741.9 ± 3.4b. These cross section values were used to calculate the Westcott g_f-factor for a 20.44°C Maxwellian neutron distribution with as result g_f = 1.0553 ± 0.0013. (auth)

28531 TOTAL CROSS-SECTION OF NATURAL URANIUM FOR FAST NEUTRONS IN THE ENERGY RANGE (0.8-9.0 MeV). Syme, D. B. C. B.; Kellie, J. D.; McKeown, J.; Hall, S. J.; Crawford, G. I. (Univ. of Glasgow). Ann. Nucl. Sci. Eng.; 1: No. 5, 305-309(May 1974).

The total cross section of natural uranium for fast neutrons in the energy range 0.8 to 9.0 MeV was measured, with good resolution and statistical precision, using a time-of-flight spectrometer based on an electron linear accelerator as neutron source. The results are compared with other recent data, with the recommended ENDF/B III evaluation, and with theoretical calculations. (auth)

28532 MASS-YIELD DISTRIBUTIONS IN THE REACTION OF ^{84}Kr IONS WITH ^{238}U. Kratz, J.V.; Norris, A.E.; Seaborg, G.T. (Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). Phys. Rev. Lett. 33: No. 8, 502-505 (19 Aug 1974).

Yields of 156 nuclides were measured radiochemically to delineate the mass distribution in the reaction of 605-MeV ^{84}Kr with thick ^{238}U

targets. The yields are consistent with decomposition of the mass distribution into five components: transfer products (700±120 mb), "quasi-Kr" products centered at A≃85 (470±70 mb) and the products from symmetric fission of their complements (420±60 mb), products from low-energy fission of Z≃92 nuclides (200±40 mb), products from complete fusion-fission (55±15 mb), and unexplained neutron-deficient yields at A≃195 (~40 mb). (auth)

28533 ASYMMETRIC FISSION. Fong, P. (Physics Department, Emory University, Atlanta, Georgia 30322). Phys. Rev. C 10: No. 3, 1122-1123 (Sept 1974).

The potential energy surface recently calculated by Mustafa, Mosel, and Schmitt is used for the calculation of the mass distribution curve of fission products of ^{235}U in thermal neutron fission based on the statistical theory. The results obtained agree well with the experimental curve. The physical significance of the agreement is discussed. (auth)

28534 COULOMB EXCITATION OF VIBRATIONAL-LIKE STATES IN THE EVEN-A ACTINIDE NUCLEI. McGowan, F.K.; Bemis, C.E. Jr.; Milner, W.T.; Ford, J.L.C. Jr.; Robinson, R.L.; Stelson, P.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 10: No. 3, 1146-1155 (Sept 1974).

Coulomb excitation of vibrational-like states in the even-A actinide nuclei ($230 \leq A \leq 248$) was measured using ^{4}He ions in order to test nuclear models describing these states. In particular, the one-phonon octupole vibrational interpretation of the low-lying negative parity states provides an interesting theoretical framework with which to compare the experimental information. The excitation probabilities were determined relative to the elastic scattering by the observation of elastically and inelastically scattered ^{4}He ions using a split-pole magnetic spectrometer equipped with a position-sensitive proportional detector. The values of $B(E\lambda, 0_g \rightarrow J = \lambda)$ range from 0.5 to 4 single-particle units for $\lambda = 2$ and from 10 to 30 single-particle units for $\lambda = 3$. For those cases, where the K, $J\pi$ assignments are known, the agreement between the experimental results and the microscopic calculations by Neegard and Vogell of the B(E3, 0 → 3) for the 3$^-$ members of the one-phonon octupole quadruplet is good when the Coriolis coupling between the states with K and K ± 1 is taken into account. The magnitudes of the reduced E0 nuclear matrix elements, ρ (E0, $2_\gamma \rightarrow 2_g$), extracted from the E0 transition probabilities, T(E0, $2_\gamma \rightarrow 2_g$), for decay of the β-vibrational-like 2^+ state are 0.37 ± 0.06 and 0.43 ± 0.06 for ^{232}Th and ^{238}U, respectively. Several 2^+ states observed in this Coulomb excitation reaction survey are presumed to be 2^+ members of rotational bands based on 0^+ excited states which are strongly populated in the (p, t) reaction. (auth)

28535 DETERMINATION OF E2 AND E4 TRANSITION MOMENTS IN ^{232}Th. Baktash, C.; Saladin, J.X. (University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. C 10: No. 3, 1136-1139 (Sept 1974).

In a precision Coulomb excitation experiment, 16.5 and 17.0 MeV ^{4}He projectiles were employed to measure the electric quadrupole and hexadecapole transition matrix elements of the ground state rotational band of ^{232}Th. The results are $\langle 0^+ \| \mathfrak{M}(E4) \| 2^+ \rangle = 3.035 \pm 0.030$ e b and $\langle 0^+ \| \mathfrak{M}(E4) \| 4^+ \rangle = 1.36 \pm 0.14$ e b^2. Model-dependent β_2 and β_4 deformation parameters are then extracted. (auth)

28536 ^{238}U GIANT RESONANCES AND THE ^{238}U(p, p') REACTION AT E_p = 66 MeV. Lewis, M.B.; Horen, D.J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 10: No. 3, 1099-1102 (Sept 1974).

Measurements of inelastic proton spectra in the region 0-25-MeV excitation energy have been made for the ^{238}U(p, p') reaction using 66-MeV protons. Two new strongly collective excitation regions of ^{238}U were discovered at $E_x \simeq 1.6$-2.0 MeV and $E_x \simeq 10$-13 MeV. The ≃1.8-MeV excitation region is complex, and its angular distribution is consistent with L = 3 and L = 2 groups. The collective resonance region at 10-13 MeV appears to have an L = 2 angular distribution with strength to exhaust most of the energy-weighted sum rule, although L = 3 and 4 components cannot be rigorously excluded. The remaining excitation region accounts for most of the cross-section strength in the reaction and consists of a relatively smooth continuum background. The results are discussed in terms of the Nilsson model. (auth)

Nuclear Theory

Refer also to abstracts 28124, 28128, and 28448.

28537 (AED-CONF-74-042-020) HARTREE-FOCK CALCULATIONS FOR HIGHLY DEFORMED AND EXCITED NUCLEI. Zint, P.G.; Passler, K.H.; Mosel, U. (Giessen Univ. (F.R. Germany). Inst. fuer Theoretische Physik). 1974. 10p. (In German). (CONF-740322-(Absts)). INIS.

From conference on nuclear physics and high energy physics; Bochum, F.R. Germany (4 Mar 1974).

11 figs.

A self-consistent treatment is given of highly deformed or even separated nuclear structures by using an expansion into eigenfunctions of the symmetric two-center oscillator. These eigenfunctions allow a natural description of the transition from a single nucleus to two separated fragments, and represent a generalization of the usual oscillator functions. Results for the systems ^{8}Be → α + α and ^{32}S → ^{16}O + ^{16}O are discussed. After a slight modification calculations are done with the same code for excited nuclei in thermal equilibrium. These allow for the first time a self-consistent calculation of the reaction of high excitation energy on the nuclear structure. (GE)

28538 (IAE-2264) DISTRIBUTION OF MULTIQUASI-PARTICLE STATES FOR SPHERICAL AND DEFORMED NUCLEI. Nemirovskii, P. Eh.; Manevich, L. G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 16p. (In Russian). INIS.

The distribution of multiquasiparticle excited states according to momentum and energy was examined for deformed and spherical nuclei within the framework of the model of degenerate Fermi gas with the energy spectra of the one-particle state cut off at the binding energy. A correction taking into consideration the pair correlation interaction between fermions was introduced. For nuclei with closed shells, where the Fermi gas spectra is unused because of the shell structure, the possibility of using the sums of Gaussian distribution was examined. The pairing effect in this case was also considered. The calculation results were compared with data on quasiparticle (p-h) states which can be obtained from data on the experimental distribution of levels. (tr-auth)

28539 NEW THEORY OF NUCLEAR FORCES. RELATIVISTIC ORIGIN OF THE REPULSIVE CORE. Gross, F. (College of William and Mary, Williamsburg, Virginia 23185 and Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 1, 223-242 (1 July 1974).

A relativistic, three-dimensional wave equation which restricts one of the two interacting particles to its mass shell is applied to the study of nuclear forces. In the nonrelativistic limit, the equation reduces to a Schrödinger equation with effective potentials composed of two parts. One part, with longer range, is similar to nonrelativistic potentials obtained from other theories, while a second short-range part, which arises solely from the relativistic nature of this equation, is repulsive and dominates over the longer-range part at short distances. The resulting soft-core potentials are evaluated numerically for a simple one-particle-exchange model limited to the exchange of π, ρ, ω, and a neutral spinless meson. By adjusting four of the parameters we obtain good fits to the Reid soft-core potentials, especially in the S states. The couplings obtained are very reasonable, and the results are compared with other recent models. The general features of the theory and the quantitative details of the model are thoroughly discussed. (auth)

28540 CLASSICAL VIEW OF THE APPLICATION OF SUM RULES TO INELASTIC FORM FACTORS. Bertsch, G.F. (Department of Physics and Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 10: No. 2, 933-934 (Aug 1974).

Classical arguments are given to show why the Tassie model of form factors can be derived from a doorway hypothesis. (auth)

28541 PION-NUCLEON ABSORPTION OPERATOR AMBIGUITY. Friar, J.L. (Department of Physics, Brown University, Providence, Rhode Island 02912). Phys. Rev. C 10: No. 2, 955-957 (Aug 1974).

In agreement with recent results it is shown that the pion-nucleon absorption operator depends on the nucleon single-particle potential's Lorentz transformation properties. This is essentially the same result as for the nuclear magnetic moment problem, these terms being of relativistic order [i.e. $(v/c)^2$ corrections] in both problems. There exists a unitary equivalence of various forms of the absorption operator, but if handled consistently this leads to the same physical results. (auth)

28542 CHARGE SYMMETRY OF NUCLEAR FORCES AND NUCLEON-NUCLEON SCATTERING EXPERIMENTS. Arnold, L.G. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. C 10: No. 2, 923-924 (Aug 1974).

Recent work on the model dependence of the Coulomb subtraction procedure for nuclear potential models is discussed. (auth)

28543 MANY-PARTICLE STATES OF THE ANISOTROPIC OSCILLATOR. Draayer, J.P. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627); Williams, S.A. Phys. Rev. C 10: No. 2, 901-908 (Aug 1974).

The invariance under canonical transformations of the fundamental Cartesian coordinates and conjugate momenta commutators is used to show that the state labeling schemes of Elliott and Moshinsky are

applicable to the case of many particles in an anisotropic harmonic oscillator potential. The relationship of the states obtained to the group theoretically equivalent isotropic harmonic oscillator states is investigated. The results reveal explicitly the collective nature of the particle–hole structure induced by the deformation. (auth)

28544 SYSTEMATICS OF REACTION CROSS SECTIONS AND INTERACTION BARRIERS FOR CHARGED PARTICLES. Vaz, L.C.; Alexander, J.M. (Department of Chemistry, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. C 10: No. 2, 464-478 (Aug 1974).

Experimentally determined total reaction cross sections σ_R have been used to obtain the systematics of interaction barriers in reactions between charged nuclei. The real potential was assumed to be parabolic at its maximum, and hence the characteristic parameters are barrier height, radius, and curvature, E_0, R_0, and $\hbar\omega_0$, respectively. Barrier heights and radii follow clear systematic trends, and therefore these systematics can be used to predict total reaction cross sections for energies close to and greater than the barrier. Experimental data for incident energies below the barrier are sparse, and therefore they cannot be well systematized at this time. The cross section patterns for low incident energies seem to reflect individuality of the collision partners. (auth)

28545 DYNAMIC SINGLE–PARTICLE EFFECTS IN FISSION. Boneh, Y. (Nuclear Research Center, Negev, Beersheva, Israel, and Weizmann Institute of Science, Rehovot, Israel); Fraenkel, Z. Phys. Rev. C 10: No. 2, 893-900 (Aug 1974).

We calculate for a model nucleus the single–particle excitations in the transition from the saddle point to the scission point in the fission process. The model nucleus consists of a square well potential of finite depth filled with noninteracting "protons" and "neutrons." At every stage of the transition between the saddle point and scission point the shape of the potential surface is equal to the surface of the fissioning nucleus as predicted by the liquid–drop model, but the depth of the potential is held constant. The rate of change of the nuclear surface is assumed to be equal to that predicted by the dynamical liquid–drop–model calculations of Nix. It is found that for this time scale there is a small probability for the particles to be raised to levels above the potential well and thus be emitted from the nucleus. The calculated number of emitted neutrons and protons is in qualitative agreement with the experimental results for the emission of scission neutrons and protons. However, there is a large energy transfer from the collective to the single–particle degrees of freedom, and hence the transition cannot be considered adiabatic for this time scale. The inclusion in the model of a residual interaction is expected to reduce both the number of particles emitted and the energy transfer from the collective to single–particle degrees of freedom, thus making the transition more nearly adiabatic. (auth)

28546 COMMENT ON PAULI BLOCKING IN PION–NUCLEUS SCATTERING. Weber, H.J.; Eisenberg, J.M. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. C 10: No. 2, 925-927 (Aug 1974).

A modified solution is presented for the Chew–Low equations in nuclei, in the presence of Pauli blocking. The resulting scattering amplitude has more satisfactory behavior at low energies (for pionic atoms), while supporting use of a blocked amplitude in the region of the 3,3 resonance. (auth)

28547 CENTER–OF–MASS EFFECTS IN SINGLE–NUCLEON KNOCK–OUT REACTIONS. Dieperink, A.E.L.; de Forest, T. Jr. (Instituut voor Kernphysisch Onderzoek, Oosterringdijk 18, Amsterdam, The Netherlands). Phys. Rev. C 10: No. 2, 543-549 (Aug 1974).

Center–of–mass corrections for quantities observed in single–nucleon knock–out reactions like (e, e'p) are discussed. Explicit results are obtained for the momentum distributions, occupation probabilities, and single–particle energies in the framework of the harmonic oscillator model. (auth)

28548 MULTIPLE DIFFRACTION THEORY, OPTICAL POTENTIALS, AND AN ALTERNATIVE APPROACH TO HIGH–ENERGY SCATTERING BY NUCLEI. Hahn, Y. (Department of Physics, University of Connecticut, Storrs, Connecticut 06268). Phys. Rev. C 10: No. 2, 585-600 (Aug 1974).

A formally exact perturbation expansion of the high–energy scattering amplitude by nuclei is developed, in which the leading term is given by the Glauber's multiple diffraction amplitude. The leading correction terms are examined in detail, which deal with the two approximations involved in the Glauber amplitude; (a) the linearization of the Green's function and (b) the fixed–scatterer assumption. Thus, the diffraction amplitude can be systematically improved rather simply so long as the scattering angle is not too large. It is stressed that, when the target profile function is replaced by the individual nucleon profiles, the correction to the linearization approximation is automatically included to all orders in the Glauber amplitude, insofar as the nonoverlapping interactions are concerned. The contents of the Glauber wave function are then analyzed to show explicitly that, within the approximations (a) and (b), the major part of the inelastic channel information, and thus of the optical potential, is already included in the theory. By comparing the diffraction theory with the optical potential approach, which is based on the multiple scattering theory and the conversion of the optical potential to a set of coupled equations, we exhibit a close connection between the two seemingly diverging approaches. As a result of this analysis, we derive a modified theory of high–energy scattering by nuclei, in which the elastic component is to be treated exactly without the linearization while the inelastic component is taken directly from the diffraction theory. (auth)

28549 RELATIVISTIC WAVE FUNCTIONS FOR PION–NUCLEON AND PION–NUCLEUS SCATTERING. Celenza, L.S.; Liou, M.K.; Liu, L.C.; Shakin, C.M. (Department of Physics and Institute for Nuclear Theory, Brooklyn College of the City University of New York, Brooklyn, New York 11210). Phys. Rev. C 10: No. 2, 435-444 (Aug 1974).

We use a modification of the method of Blankenbecler and Sugar to discuss various reductions of the Bethe–Salpeter equation to three–dimensional equations. Pion–nucleon and pion–nucleus scattering are treated, and the advantages of the use of different Green's functions are indicated. For the case of pion–nucleus scattering we propose a relativistic optical model. The relation of the wave functions resulting from the solution of the three-dimensional equations to the Bethe–Salpeter wave function is indicated. Our method should be particularly useful in providing a framework in which phenomenological studies of the off–shell pion–nucleon T matrices may be made, since the relationship of our (relativistic) three–dimensional equations to manifestly covariant theory has been made explicit. (auth)

28550 MANY–BODY FORCES AND THE BINDING ENERGY OF HIGH–DENSITY NUCLEAR MATTER. McKellar, B.H.J. (School of Physics, University of Melbourne, Parkville, Victoria Australia 3052); Rajaraman, R. Phys. Rev. C 10: No. 2, 871-887 (Aug 1974).

The total contribution of all intrinsic pion–exchange many–body forces to the binding energy of nuclear matter is obtained in terms of an integral equation, the kernal of which includes the effect of pairwise correlations between the nucleons. This integral equation is solved for simple cases of the πN interaction, and it is found that the resulting contribution to the energy increases rapidly as a function of the density, even in the presence of correlations. However, at very high densities we find that for a large class of many–body potentials the correlations completely suppress the contribution to the energy of forces involving four or more nucleons. (auth)

28551 A COUPLED–CHANNEL TREATMENT OF BARYON RESONANCES IN NUCLEI. Jena, S.; Kisslinger, L.S. (Physics Department, Carnegie–Mellon University, Pittsburgh, Pennsylvania 15213). Ann. Phys. (N.Y.) 85: No. 1, 251-282 (30 May 1974).

A coupled–channel treatment of the two–baryon system is carried out in order to study the effects of baryon–resonance components in nuclear states. The coupling potentials are derived in a static one–pion–exchange model, and a one–boson–exchange interaction is used in the two–nucleon channel. For the deuteron, the wave function of the Δ (1236)–Δ (1236) component is calculated and found to have high Fourier components. For N–N scattering the Δ (1236) components are shown to account for much of the intermediate range attraction for which scalar mesons are introduced in one–boson–exchange models. (auth)

28552 SIZE OF BARELY BOUND MANY–BODY SYSTEMS. Calogero, F.; Simonov, Y.A. (Institute of Theoretical and Experimental Physics, Moscow, Union of Soviet Socialist Republic). Phys. Rev. Lett. 33: No. 7, 436-439 (12 Aug 1974).

It is pointed out that, in contrast to the case of S–wave two–body bound states, the size of a many–body bound states remains finite (irrespective of its angular momentum) even if its binding energy vanishes. Physical implications for barely bound many–body systems are outlined. (auth)

28553 DIFFRACTION, REFRACTION, AND INTERFERENCE PHENOMENA IN HEAVY–ION TRANSFER REACTIONS. Friedman, W.A.; McVoy, K.W.; Shuy, G.W.T. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. Lett. 33: No. 5, 308-312 (29 July 1974).

The forward–angle oscillations recently observed in heavy–ion transfer reactions are explained as the Young interference pattern of a refractive two–slit "optical system" in l space, and a new phenomenon is predicted. (auth)

28554 HIGH–ENERGY APPROXIMATIONS TO NUCLEAR SCATTERING. Frahn, W.E.; Schürmann, B. (Physics Department, University of Cape Town, Rondebosch (Cape), South Africa. Ann. Phys. (N.Y.) 84: No. 1, 147-164 (15 May 1974).

Starting from Glauber's eikonal approximation, we develop systematic approximation procedures for high–energy nuclear scattering based on

expansions of the free–space propagator. We distinguish two different expansions, the "eikonal expansion" and the "Fresnel expansion," and interpret their physical meaning in optical terms. In Fresnel approximations we derive, by means of a unitary transformation, a closed representation of the scattering amplitude which is formally similar to Glauber's expression. In the present paper these approximation methods are formulated for potential scattering; application to multiple scattering in nuclei will be described in a subsequent article. (auth)

28555 THE SEMICLASSICAL SINGLE–PARTICLE DENSITY OF STATES. Jennings, B.K. (McMaster University, Hamilton, Ontario, Canada). Ann. Phys. (N.Y.) 84: No. 1, 1-7 (15 May 1974).

An expression for the semiclassical density of states for a particle in a smooth potential well is obtained from the Kirkwood expansion of the partition function; the result being valid for a finite as well as an infinite potential well. The expression obtained for the semiclassical density of states in this paper is then shown to be essentially equivalent to the expression obtained from the Green's function method of Balian and Bloch. (auth)

28556 THE INTERACTING BOSON MODEL. Feshbach, H. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Iachello, F. Ann. Phys. (N.Y.) 84: No. 1, 211-231 (15 May 1974).

A relatively quick and correspondingly rough procedure is developed to deal with complex nuclear excitations. This procedure exploits the existence in nuclei of collective excitations (phonons) by replacing the many fermion degrees of freedom with fewer boson degrees of freedom. The emerging picture is that of an interacting boson gas. The boson–boson interaction and boson annihilation graphs are explicitly constructed. It is shown that the interacting boson approximation (IBA) gives good results when applied to the structure of ^{16}O. The limitations of the model are briefly discussed. (auth)

28557 PHENOMENOLOGY OF PIONIC NUCLEON CAPTURE. Reitan, A. Ark. Fys. Seminar Trondheim; No. 3, 1-21 (1974).

The (p,π) reaction is studied at a phenomenological, rather than a dynamic level in an attempt to arrive at a useful and consistent method for a first-order analysis of such reactions. The description used bears a close resemblance to the Butler theory for nuclear stripping and pickup reactions, but the inclusion of the two-nucleon mechanism makes it of necessity somewhat more complicated. Experimental results obtained at 185 MeV incident energy are compared with the calculated values. (J.I.W.)

28558 DETERMINATION OF THE ALLOWED STATES OF A MANY-PARTICLE SYSTEM WITH DEFINITE STATES OF THE SUBSYSTEMS. Kaplan, I. G.; Rodimova, O. B. (Inst. of Atmospheric Optics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1560-1569(May 1974). (In Russian).

A method is developed for determining the allowed states of a many-particle system with definite states of the subsystems (impurity ion complex in crystals, nucleon clusters in nuclei, polyatomic molecules). The advantage of the method proposed over those previously developed is that the present one is independent of the number of particles in the subsystems. Each subsystem is characterized by a spin value S_a and an irreducible representation $\Gamma^{(\alpha_a)}$ of the point symmetry local group. Depending on the value of S_a the subsystems behave either as bosons or fermions on permutation. Formulas are derived for the character of the reducible representation formed by coordinate wave functions of the system, the functions possessing a certain symmetry with respect to subsystem permutation. Resolution of this representation into irreducible parts yields allowed representations $\Gamma^{(\alpha)}$ of the point symmetry group of the system. The allowed values of spin S of the system can be found from the table of reduction of the unitary transformation group U_{2S_a+1} in a three-dimensional rotation group. The relation between the present method and the plethysm operation is obtained. It is shown that the permutation factors obtained previously may be expressed in terms of 3nj symbols. A previous method can therefore be made independent of the number of particles in the subsystem and indicates the existence of a relation between the 3nj symbols and plethysm coefficients. The case when spin-orbit interaction within the subsystem is taken into account is considered separately. Some examples of application of the method to various systems are presented. (auth)

28559 KINETICS OF STIMULATED γ-EMISSION UNDER TRANSITION CONDITIONS. Vorontsov, V. I.; Vysotskii, V. I. (Kiev State Univ.). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1528-1536 (May 1974). (In Russian).

Some features of the kinetics of stimulated γ-emission for various values of the broadening factor are considered on basis of the quasiclassical equation set by taking into account the dependence of the stimulated emission cross section on time. The characteristics of the developing wave in the γ range and optical range in transition conditions are compared. The concepts of an optimal time interval and active layer length are introduced for natural width lines and their values for a real case are determined. (auth)

28560 CONNECTION BETWEEN THE CLASSICAL AND QUANTUM MECHANICAL TREATMENT OF THE FORWARD CAPTURE OF A LIGHT PARTICLE IN THE HIGH VELOCITY LIMIT. Shakeshaft, R. (New York Univ.). J. Phys., B (London); 7: No. 9, 1059-1065(21 Jun 1974).

In the high velocity limit there ought to exist a connection between the correct classical and quantum mechanical treatments of the forward capture of a light particle. By means of a semi-classical treatment it is shown that there is a proper connection between the classical treatment of Thomas (Proc. R. Soc.; A114: 561-76 (1927)) and the second Born approximation. (auth)

28561 TWO-PARTICLE–TWO-HOLE LEVELS IN NUCLEI IN THE GREEN'S FUNCTION METHOD. Kamerdzhiev, S. P. JETP Lett. (USSR) (Engl. Transl.); 19: No. 8, 287-288(20 Apr 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 8, 545-548(20 Apr 1974).

Microscopic equations that describe two-phonon levels in nuclei and their connection with single-phonon levels are obtained within the framework of the Green's function method. (LBS)

28562 π CONDENSATE AND DATA ON THE SCATTERING OF ELECTRONS BY NUCLEI. Migdal, A. B. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 8, 284-285(20 Apr 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 8, 539-542(20 Apr 1974).

The hypothesis is advanced that the experimentally observed distortion of the scattering curve at momentum transfer $q \approx 3$ F^{-1} is due to the layered nuclear-matter structure caused by π condensation. Other possible experiments in which the layered structure of nuclear matter might be manifest are discussed. (auth)

28563 SIMPLE METHOD TO CALCULATE TWO-BODY OSCILLATOR MATRIX ELEMENTS. Boschan, P.; Elbaz, E. (Universite Claude Bernard, Lyon). Acta Chim. Acad. Sci. Hung.; 36: No. 2, 185-194(1974).

A simple method is proposed to calculate two-body matrix elements without using the Brody–Moshinsky brackets. The Slater integrals are reduced to single integrals, and it is shown that in the case of Gaussian, Yukawa or Coulomb-type interactions even this last integral may be carried out. (auth)

28564 MODEL CALCULATIONS FOR FORM AND SPECTROSCOPIC FACTORS IN STRIPPING TO RESONANT STATES. Lovas, R. G. (Inst. of Nuclear Research, Debrecen, Hungary). Acta Chim. Acad. Sci. Hung.; 36: No. 2, 165-178(1974).

By some model calculations it is shown that for narrow resonances the single-particle and coupled channel resonance functions defined by different prescription (scattering, Gamow, Weinberg solutions) are nearly identical. Only those stripping processes might or do distinguish the resonant functions whose final state is a broad resonance or a resonance in a surface-coupled or complex coupled channel process or the contribution to the transition matrix element from the region outside the nucleus are important. A definition for the spectroscopic factor of a Gamow state is given. According to some numerical examples it satisfies the physical expectation. (auth)

28565 NONPERTURBATIVE APPROXIMATION SCHEMES FOR THE EFFECTIVE INTERACTION IN NUCLEI. Hofmann, H.M.; Lee, S.Y.; Richert, J.; Weidenmüller, H.A. (Max–Planck–Institut für Kernphysik and Institut für theoretische Physik der Universität, Heidelberg, Germany); Schucan, T.H. Ann. Phys. (N.Y.) 85: No. 2, 410-437 (June 1974).

Several methods are investigated to deal with the singularities of the effective interactions which cause the perturbation series to diverge. Some of these methods, which are found to be quite useful, are based upon a semiphenomenological treatment of the "intruder" states. One method, based upon the use of Padé approximants, seems to be free of such semiphenomenological input data and appears to yield a particular effective interaction which has as eigenvalues those levels of the system for which the corresponding eigenfunctions have maximum overlap with the model space. The methods are investigated with the help of simple examples. Those methods which are found to be useful are applied to the 0^+ and 2^+ levels of ^{16}O. (auth)

28566 ENERGY DEPENDENCE OF THE VOLUME INTEGRALS OF THE ^3He OPTICAL POTENTIAL. Simbel, M.H. (Max–Planck–Institut für Kernphysik, Heidelberg, West Germany). Phys. Rev. C 10: No. 3, 1083-1086 (Sept 1974).

The strong energy dependence of the volume integrals of the ^{3}He optical potential observed recently is shown to be due to the effect of the disintegration of the projectile. (auth)

28567 GALILEAN–INVARIANCE AMBIGUITY IN THE NONRELATIVISTIC PION–NUCLEON ABSORPTION OPERATOR. Bolsterli, M.; Gibbs, W.R.; Gibson, B.F.; Stephenson, G.J. Jr. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. C 10: No. 3, 1225-1226 (Sept 1974).

In the model of a nucleon interacting with a massive object via a potential in the Dirac equation, we have demonstrated that the behavior of the nonrelativistic pion absorption operator under Galilean transformations depends upon the properties of the potential under Lorentz transformations. In particular, the operator has a Galilean invariant form if the potential is the time–like component of a four–vector, but not if the potential is a scalar. (auth)

28568 INDUCED COULOMB CORRECTIONS TO NUCLEAR BETA DECAY. Holstein, B.R. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. C 10: No. 3, 1215-1219 (Sept 1974).

The recent calculation by Bottino, Ciocchetti, and Kim of induced Coulomb effects in nuclear β decay is generalized to include arbitrary allowed decay, the induced tensor, and additional spectral functions. (auth)

28569 ANALYTIC DISTORTED WAVES FOR INTERMEDIATE–ENERGY ALPHA PARTICLES. Janus, R.T.; McCarthy, I.E. (School of Physical Sciences, The Flinders University of South Australia, Bedford Park, South Australia 5042, Australia). Phys. Rev. C 10: No. 3, 1041-1044 (Sept 1974).

It is shown that physically consistent and realistic values of all the parameters can be found for a model that represents the distorted waves in the distorted–wave Born approximation for collective α inelastic scattering by a properly normalized decaying plane wave. The significance of this achievement in a thoroughly understood reaction is that we are now able to obtain analytic distorted waves that are sufficiently realistic and sufficiently simple to use in off–shell distorted–wave impulse approximation calculations of reactions of current interest requiring microscopic descriptions of the reaction mechanism. (auth)

28570 ANGLE TRANSFORMATION FOR THE π–NUCLEUS OPTICAL POTENTIAL. Miller, G.A. (Department of Physics, Carnegie–Mellon University, Pittsburgh, Pennsylvania 15213). Phys. Rev. C 10: No. 3, 1242-1245 (Sept 1974).

A simplified form of the pion optical potential which includes the p–wave threshold kinematics for the angle transformation is presented. Numerical results are given, and a comparison with the work of several others is made. (auth)

28571 THE RECURSIVE PERTURBATION METHOD AND ITS APPLICATION TO THE STUDY OF NUCLEAR SHELL MODELS. Hioe, F.T. (Institute for Fundamental Studies, Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). J. Math. Phys. (N.Y.) 15: No. 10, 1615-1619 (Oct 1974).

The recursive perturbation method given previously by the author is generalized and applied to the calculation of the energy levels of nuclear shell models. Specifically, we consider a numerically exactly soluble model of interacting fermions with SU(3) symmetry studied by Li, Klein, and Dreizler. The method can be obviously extended to the study of more general models with SU(n) symmetry. (auth)

28572 HYPERFRAGMENTS PRODUCED FROM K^- CAPTURE. Goel, S.P. (Kurukshetra Univ. (India). Dept. of Physics); Prakash, Y. (Jammu Univ. (India). Dept. of Physics). Nucl. Phys., B; 74: No. 1, 167-188(18 May 1974).

Characteristics of hyperfragments produced from K^- capture in nuclear emulsion are investigated through computer simulation and compared with corresponding experimental results. The nuclear cascade is completely simulated and the nucleus is deexcited through evaporation after estimating the excitation energy. Characteristics of hyperfragments particularly their mass distribution and the prong distribution of their production star can be used in favour of the peripheral hypothesis of K^- absorption. The calculated and the observed range distributions of the heavy hyperfragments are not in complete agreement, a feature leading to the inference that spallation may not be the only process responsible for the production of such hyperfragments. (auth)

28573 A PROGRAM TO EVALUATE THE REDUCED MATRIX ELEMENTS OF ONE-PARTICLE TENSOR OPERATORS FOR THE CONFIGURATIONS IN JJ-COUPLING. Chang, J.J. (Queen's Univ., Belfast, Northern Ireland (UK). Dept. of Applied Mathematics). Comput. Phys. Commun.; 7: No. 4, 225-234 (Apr 1974).

In relativistic atomic calculations and nuclear shell theory, many problems involve matrix elements of one-particle tensor operators, such as electric and magnetic multipole transitions. The program is designed to evaluate the angular part of these matrix elements between arbitrary configurations in jj-coupling. Configurations are defined by the number of electrons and the (nk) quantum numbers in each occupied shell and coupling intermediate angular momenta. The angular integral of the reduced matrix element is expressed in terms of recoupling coefficients and coefficients of fractional parentage. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 27056, 27081–27083, 27087, 27097, 27103, 27113, 27141, 27147, 27174, 27238, 27489, 27491, 28047, 28050, 28112, and 28484.

28574 (AD–774445) CONSTRAINTS UPON GROUP-TO-GROUP SCATTER COEFFICIENTS USED WITH TRANSPORT CALCULATIONS. Webster, J. B. III. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Dec 1973. 146p. (DS/PH–73-5). NTIS $10.50.

Thesis.

A set of constraints was formulated to test the higher order coefficients of a Legendre polynomial expansion for the angular dependence of the differential cross section which describes the scattering of x-ray energy photons with non-stationary electrons. Prior workers have developed numerical methods which generate these coefficients for both discrete and groupwise treatments of radiative energy transfer. Such coefficients were constrained to obey the principles of conservation of total cross section and detailed balance at equilibrium. This conservation principle provided a test only for the zero order coefficients to chance. By generalizing the conservation principle to apply to higher order coefficients, and providing the necessary values of averaged polynomials for given initial photon energies, the author developed a method for testing these higher order coefficients. (GRA)

28575 (AD–775128) SPATIAL DISTRIBUTION OF DOSE RATE FROM A POINT ISOTROPIC NEUTRON SOURCE IN AIR AND AT THE AIR–GROUND INTERFACE. Degtyarev, S. F.; Kukhtevich, V. I. Translated by P. J. Reiff From Vop. Fiz. Zashch. Reaktorov; No. 2, 210-215(1966). 13p. NTIS $4.00.

28576 (AD–775319) MONTE CARLO CALCULATIONS OF DOSE DISTRIBUTION IN SEM IRRADIATED SEMICONDUCTOR STRUCTURES. Final Report, 18 May–18 October 1973. Chadsey, W. L. (Science Applications, Inc., Arlington, Va. (USA)). 18 Oct 1973. 27p. NTIS $4.50.

Monte Carlo calculations were performed to determine the two-dimensional dose distribution in a metal/oxide/silicon substrate structure irradiated by the electron beam from a scanning electron microscope (SEM). The objective was to investigate energy deposition in transistors neighboring an MOS capacitor test pattern irradiated by a SEM electron beam. The principal conclusion is that no damage to neighboring transistors is predicted–the dose in the oxide layer 2 microns from the boundary of the test pattern is four orders of magnitude smaller than the soe dose in the test pattern oxide for a 20 keV beam. Plots and tables of depth dose distribution, radial dose distribution, dose distribution near a rectangular target pattern, charge deposition distribution, and radial distribution of reflected charge are presented. (auth)

28577 (BMFT-FB-T-74-06) ELECTRON ENERGY LOSS SPECTROMETRY. Kraus, W. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany)). May 1974. 31p. (In German). INIS.

16 figs.; 3 refs. With abstract in German and English. Available from ZLDI.

Electrons interacting with matter can undergo energy losses characteristic of the kind of matter concerned. The characteristic losses should be usable for microanalysis. The equipment for electron energy loss spectrometry essentially consists of the electron optical column and of the spectrometer. 40 to 100 kV electrons penetrate the specimen. Part of them suffers energy losses, which are examined by a retarding potential analyzer. A multichannel analyzer used as multiscaler controls the process by means of an opto-electronic signal transmitting line and stores the pulses sent from the detector along the transmitting line. (auth)

28578 (CONF-730907-P1, pp 225-228) DOSE EQUIVALENT EQUATION. Wyckoff, H. O. (International Commission on Radiation Units and Measurements, Washington, DC). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The dose equivalent is a quantity determined in an organ or tissue of the body of a person and related to the presumed risk of radiation induced injury to that organ or tissue. The use of this quantity is limited to radiation protection applications and should not be used for high level accidental exposures. The equation used in the determination of dose equivalent is included. (CH)

28579 (CONF-730907-P1, pp 229-231) INDEX QUANTITIES OF THE ICRU. Rossi, H. H. (Columbia Univ., New York). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In its last report on radiation quantities and units (ICRU Report 19, 1971) the International Commission on Radiation Units and Measurements (ICRU) defined the Absorbed Dose Index (D_I) and the Dose Equivalent Index (H_I) for employment in radiation protection. The explanatory statements provided by the Commission are rather brief and it appears that some misconceptions have arisen with regard to these quantities. The reasons for the introduction of these quantities and their utility, as well as their limitations, are discussed. (CH)

28580 (CONF-730907-P1, pp 232-241) UNITS IN IONIZING RADIATION. Allisy, A. (Bureau International des Poids et Mesures, Sevres, France). Feb 1974. (In French).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The present positions of the Comité International des Poids et Mesures and the International Commission on Radiation Units and Measurements regarding the use of the International System of Units (SI) are given. Physical quantities and units are briefly considered with special reference to coherence. A few simple rules are given concerning the symbols and units. (auth)

28581 (CONF-730907-P1, pp 654-658) NEED FOR AN OPERATIONAL RADIATION DOSE INDEX SYSTEM. Harris, S. J. (Dept. of Health, New York). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Association.

There exists a need to have developed an operational radiation dose index system which can show, in a single unit, the combined effect upon individual or public health of the following parameters: exposure rate or radioactive material decay characteristics, the duration of the exposure, the effective volume of irradiated tissue, the biological sensitivity of each exposed organ or functioning part of the body, the genetic implications from the exposure (if any), the possibility of repetition of the exposure, the recuperative ability of the exposed volume, and the net value of the exposed volume to the individual. Arbitrary decisions for some of these factors would need to be made by expert committees on a scale of 1 to 100. Some preliminary calculations are presented for several specific exposure conditions, such as a chest radiograph, a G.I. series, whole-body occupational-limit exposure, and whole body population-limit exposure. (auth)

28582 (CONF-730907-P1, pp 671-676) CORRELATION BETWEEN FAST NEUTRON DOSE EQUIVALENTS AND IN VIVO ACTIVATION PRODUCTS. Schlesinger, T.; Klopfer, Y. (Soreq Nuclear Research Centre, Yavne, Israel). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The possibility of establishing a quantitative relationship between fast neutron dose and specific activation products in living tissue is discussed. Such a relationship may be useful for fast neutron dose evaluation in routine neutron therapy and following accidental neutron over-exposures. Tissue equivalent phantoms of different dimensions were exposed to 15 MeV D-T neutrons from a linear ion accelerator. The radioactivity of activation products, such as ^{13}N from the $^{16}N(n,2n)^{13}N$ reaction, ^{28}Al from the $^{31}P(n,\alpha)$ ^{28}Al reaction, ^{45}Ca and ^{38}Cl from (n,γ) reactions, were measured immediately after irradiation by a total-body counter with a sensitivity on the order of 1 nanocurie. The neutron dose was calculated and correlated to the activity of some of the activation products. (auth)

28583 (CONF-730907-P1, pp 694-699) DOSE DUE TO PRACTICAL NEUTRON ENERGY DISTRIBUTIONS INCIDENT ON CONCRETE SHIELDING WALLS. Wyckoff, J. M. (National Bureau of Standards, Washington, DC); Chilton, A. B. Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In order to calculate the dose equivalent for persons on the far side of an ordinary concrete shielding wall from a plane parallel source of neutrons, published monoenergetic neutron data and practical neutron spectra have been folded together. Some interpolation of the monoenergetic neutron data, both in energy and slab thickness, was required to prepare the data for computation in steps of 50 g/cm^2. The result is a set of useful dose-equivalent data for walls as thick as 800 g/cm^2 used to shield particle accelerators producing neutrons up to 100 MeV in energy. A simple, empirically derived, analytical expression for the dose equivalent for walls of 50 to 800 g/cm^2 thickness is given with suitable constants for neutron spectra produced by more than 60 selected examples of the following reactions: slow and fast neutron induced fission, (γ,n), (p,n), $(^3He,n)$, (α,n) and fission (γ,n). (auth)

28584 (IFVE-ORZ-73-29) PHANTOM TISSUE DOSE DISTRIBUTION FROM 30-GEV NEUTRON BEAMS. Golvachik, V. T.; Britvich, G. I.; Lebedev, V. N.; Potemkin, E. L.; Dmitrievskii, I. M.; Frolov, V. V. (Gosudarstvenny} Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 20p. (In Russian). INIS.

The results of the measurement of the absorbed dose in water phantoms irradiated with neutron beams with an average energy of 30 GeV were reported. The measurements were made with a tissue-equivalent chamber with a volume of 10 cm^3. The dose on the surface of the phantom was $(1.2 \pm 0.3) \times 10^{-9}$ rad·n^{-1}·cm^2 and the maximum absorbed dose is $(7.6 \pm 1.9) \times 10^{-9}$ rad·n^{-1}·cm^2. Calculations were made of the absorbed and equivalent doses for conditions close to the experimental conditions. The calculated and experimental results agree within the limits of error. The calculated coefficient of quality varied with the depth of the phantom from approximately 6 on the surface to 2.3 at the bottom of a layer 30 cm thick. The maximum equivalence dose in the phantom was 15.2×10^{-9} rem·n^{-1}·cm^2. (tr-auth)

28585 (UCID-15133(Rev. 1)) NOTES ON MONTE CARLO METHOD FOR NON-LINEAR RADIATION TRANSPORT IN GENERAL AND ON THE INDIGO CODE IN PARTICULAR. Nelson, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jan 1967. 14p. Dep. NTIS $4.00.

INDIGO is a Monte Carlo code designed to solve the one-dimensional nonlinear radiation transport problem in real materials. The following topics are discussed: emission, particle following, and temperatures. (MHR)

28586 (UCID-15640) NUMERICAL METHODS FOR RADIATION TRANSPORT CALCULATIONS BY FINITE-DIFFERENCE METHODS. Tooper, R. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Apr 1970. 21p. Dep. NTIS $4.25.

The following subjects are discussed: implicit methods for nonlinear radiation transport calculations, difference schemes for 1D transport, study of exact solutions, 2D transport calculations, and Compton scattering. (MHR)

28587 COMITE CONSULTATIF POUR LES ETALONS DE MESURE DES RAYONNEMENTS IONISANTS. Section II. Mesure des Radionucleides. (Consulting Committee for Measurement Standards of Ionizing Radiations. Section II. Measurement of Radionuclides). Sevres, France; Bureau International des Poids et Mesures (1972). 52p.

The Committee proceedings are presented. Discussions on the 27 preliminary reports submitted are summarized. The subjects of these reports include principles of coincidence methods, problems of microweights, measurement of decay rates, use of liquid scintillation counter for the metrology of nuclides decaying by emission of low-energy radiation, metrology of nuclides with pure electron captures, detection and evaluation of secondary pulses, 4π γ ionization chambers, coincidence measurements on ^{203}Hg, and exact methods for the dilution and calibration of radioactive solutions. No data are presented for these reports. The report on the organization of the international comparison of masses of 20, 50, and 100 mg is presented in toto, but has been published by the International Bureau of Weights and Measures as Report BIPM-73/7. (JSR)

28588 INELASTIC SCATTERING AND BEAM DAMAGE OF BIOLOGICAL MOLECULES. Isaacson, M. (Brookhaven National Lab., Upton, NY). pp 478-479 of Proceedings of the Thirty-First Annual Meeting of the Electron Microscopy Society of America. Arceneaux, C. J. (Ed.). Baton Rouge, LA; Claitor's Publishing Div. (1973).

From 31st EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973). See CONF-730816-.

The electron energy loss spectrum is shown for the nucleic acid base, adenine ($C_5N_5H_5$). The change of the energy loss spectra with irradiation can be used as a gauge of specimen damage. These effects are shown for adenine. (MHR)

28589 SLOWING DOWN OF ^{12}C*-IONS IN SILICON AND TANTALUM. Kraft, G. Koeln, Ger.; Koeln Univ. (1972). 34p. (In German). INIS.

Thesis. 19 figs.; 4 tabs.; 39 refs. With abstract in German. Available from the library of the Koeln Univ.

By means of the reaction ^{9}Be$(\alpha,n)^{12}$C, ^{12}C* ions having an excitation energy of 4.439 MeV and a kinetic energy of between 250 keV and 3.3 MeV were produced and were stopped in silicon or tantalum. The lifetime of the excited 4.4 MeV state $\tau = 5.61 \times 10^{-14}$ sec is about one order of magnitude smaller than the time which it takes to slow down the initial velocity of the ^{12}C* to zero-velocity. Thus the form of the emitted Doppler spectrum of the 4.4 MeV γ-quanta is given by the velocity distribution in the moderator material. This distribution is essentially determined by the energy loss of the ^{12}C* and by the reaction itself, that is to say by the kinematics and angular distribution of the ions and the angular distribution of the γ-quanta. In this work the form of the Doppler spectrum without slowing down is firstly determined, and then by comparison with the Doppler spectra with slowing down, the energy loss is given as a function of the velocity. Thus it is shown that the usual equation for the energy loss in lifetime measurements with the Doppler shift method is justified between 3×10^8 cm/sec and 6.5×10^8 cm/sec in the analytical form. Thereby the share of the nuclear slowing down with silicon is considerably greater than the theoretical value. Below 3×10^8 cm/sec, the energy loss with tantalum cannot be described by this equation. (GE)

28590 MEASUREMENTS OF GAMMA RAY ATTENUATIONS FOR CONSTRUCTION MATERIALS. Cameras, R.; Rickards, J. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis., Suppl. Fis. Apl.; 22: FA1-FA16(1973). (In Spanish).

Gamma ray attenuation coefficients have been measured, for commonly used Mexican building materials, between 0.1 and 1.8 MeV. In order to cover the energy interval several low intensity radioactive sources were employed. This was possible due to the use of a semiconductor Ge(Li) detector and a 4096 channel pulse height analyzer, which also permitted geometry restrictions to be relaxed. For each material studied (basalt, concrete, mortar, bricks, glass, lucite, and different types of wood) linear and mass attenuation coefficients were obtained and tenth-valve thicknesses calculated. (auth)

28591 PION DOSE CALCULATIONS SUITABLE FOR TREATMENT PLANNING. Li, G. C.; Boyd, D.; Schwettman, H. A. (Stanford Univ., CA). Phys. Med. Biol.; 19: No. 4, 436-447 (Jul 1974).

A method has been developed for calculating the biological equivalent dose distribution for pion beams which is computationally simple enough to be used in routine treatment planning. Dose distributions calculated for the irradiated of simple target volumes, using a conventional single port rectangular beam geometry and using a multiport cylindrical geometry which approximate the configuration of the Stanford pion channel, illustrated the inherent advantages of the multiport irradiation in decreasing the entrance dose and in reducing variations in the pion star fraction (pion star dose/total dose) across the target volume. It was also shown that by scanning in two dimensions the dose distribution could be made to conform to an arbitrary target volume. (auth)

28592 RANGE-ENERGY RELATIONS FOR C IONS AND O IONS IN N_2, O_2, AND TISSUE-EQUIVALENT GAS. Langley, R. A. (Sandia Labs., Albuquerque, NM). Phys. Med. Biol.; 19: No. 4, 495-503(Jul 1974).

The range-energy relations for carbon ions (0.3 to 2.5 MeV) and for oxygen ions (0.5 to 5.0 MeV) have been measured with an uncertainty of less than ±2% for the target gases N_2, O_2, and a tissue-equivalent gas (31.4% CO_2, 2.8% N_2 and 65.8% CH_4). A magnetically analyzed beam of ions was brought through a differential pumping system into a gas stopping cell. A single-grid ionization chamber, movable parallel to the beam axis, was used to obtain the data necessary to plot a Bragg curve. Comparisons with the previous data are made. (auth)

28593 DIFFERENCE EQUATION SOLUTIONS FOR NON-STEADY DIFFUSION OF CHARGED PARTICLES IN SOLIDS. Butler, W. H.; Fromhold, A. T. (Univ. of Auburn, AL). J. Phys. Chem. Solids; 35: No. 9, 1099-1113(Sep 1974).

The hopping transport of charged particles through a solid is described by means of difference equations based on the concept of classical thermal motion over discrete energy barriers. Homogeneous electric fields and concentration gradients are considered to be the driving forces for transport. Transient and

steady-state currents are derived, and the concentration profiles are obtained for the mobile charged defect species. For the case of a slab geometry the discreteness of the potential barriers leads to a nonlinear dependence of current on voltage in the high electric field limit, with a more rapid increase of current with voltage than would be expected from an extrapolation of the low field linear dependence. The field-dependent relaxation of a non-steady-state defect concentration profile to the corresponding steady-state profile can be nearly exponential in the limit of large fields. Tracer distributions for the cases of semi-infinite and unbounded diffusion mediums are likewise affected appreciably in the high field limit. The velocity of the peak is increased over that obtained by linear extrapolation from the low field limit. It is concluded that the combination of high electric fields with the natural microscopic discreteness of a solid-state diffusion medium can result in readily observable nonlinear electric field effects which increase approximately exponentially with the atomic separation distances of the discrete barriers in hopping transport. Some of this nonlinear behavior can be retained in differential equations derived from the difference equations by means of Taylor series expansions of the carrier concentration with respect to position. (auth)

28594 THE POSSIBILITY TO CHARACTERIZE THE RADIATION QUALITY OF SOFT X-RAYS BY EFFECTIVE WAVELENGTHS FOR DENSITOMETRICAL MEASUREMENTS. Wolschendorf, K.; Vanselow, K. (Kiel Univ. (F. R. Germany). Inst. fuer Angewandte Physik). Biomed. Tech.; 18: No. 6, 230-235 (Dec 1973). (In German).

3 figs.; 1 tab.; 12 refs.

A great deal of densitometrical measurements require the definition of the quality of radiation applied. This definition becomes difficult if soft X-rays are used for the irradiation experiments. In the present work the attempt is made to clarify to what extent it is possible to characterize the continuous spectral distribution of the X-rays in a simplifying manner by effective wavelengths. The applicability of this method can be estimated if the effective wavelength is determined via two different definitions and if the degree of agreement of the thus obtained values is considered a measure for the validity of this approximative characterization. (auth)

28595 RADIATION FIELD OF A UNIFORMLY MOVING CHARGE IN AN ANISOTROPIC MEDIUM. Sastry, G. P.; Datta Majumdar, S. (Indian Inst. of Tech., Kharagpur. Dept. of Physics). Z. Naturforsch., a; 29: No. 5, 687-692(May 1974).

1 fig.; 12 refs.

Fourier integrals are set up for the field of a point charge moving uniformly in an arbitrary direction in a uniaxial anisotropic in the dielectric constant only. The integrals break up into several parts, two of which yield the ordinary and extraordinary cones with uniform azimuthal potential distribution. The remaining integrals neither contribute to the energy radiated nor affect the size and the shape of the cones, but merely distort the field within the cones. The integrals are evaluated exactly in the non-dispersive case, and closed expressions for the potential are obtained. In the dispersive case, the radiation field is determined by using the asymptotic form of the Hankel functions occurring in the integrand. The resulting expressions exhibit the high azimuthal asymmetry characteristic of anisotropic fields. From the expressions derived for a pure dielectric the potential in a doubly anisotropic medium is obtained, without a fresh calculation, by making appropriate substitutions for the coordinates of the field point and the components of the dielectric tensor. (auth)

28596 ENERGY-LOSS FLUCTUATION OF HEAVY CHARGED PARTICLES IN SILICON ABSORBERS. Avdeichikov, V. V.; Ganza, E. A.; Lozhkin, O. V. (Radievyj Inst., Leningrad (USSR)). Nucl. Instrum. Methods; 118: No. 1, 247-252(1 Jun 1974).

The energy straggling of ^{4}He, ^{12}C, ^{14}N, ^{31}P and ^{40}Ar ions passing through thin uniform silicon absorbers has been studied in the range of relatively low velocity of the incident ions $\{(v/Ze^2h^{-1}) \lesssim 1\}$. The experimental results are compared with the theoretical predictions of the energy-loss fluctuation: it is suggested that the fluctuation of the effective charge of the ions is primarily responsible for the existing discrepancy between measured and theoretical energy-loss distributions for heavy ions, but there is rather good agreement for α-particles. (auth)

28597 PROGRAMS FOR THE LANDAU AND THE VAVILOV DISTRIBUTIONS AND THE CORRESPONDING RANDOM NUMBERS. Schorr, B. (European Organization for Nuclear Research, Geneva (Switzerland)). Comput. Phys. Commun.; 7: No. 4, 215-224(Apr 1974).

The Landau and the Vavilov distributions are used to describe the energy loss of charged particles traversing a thin layer of matter. For Monte Carlo simulations it is of particular interest to have a random number generator for these distributions. Fourier series are used to approximate the probability density functions, the cumulative distribution functions and the inverses of the conditional distribution functions. (auth)

Radiation Protection Standards

Refer also to abstracts 27056, 27059, 27060, 27062, 27063, 27065, 27067, 27103, 27104, 27126, and 28578–28580.

28598 (CONF-730907-P1, pp 1-7) U.S. CONGRESS AND RADIATION PROTECTION. Price, M. (Joint Committee on Atomic Energy, Washington, DC). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The role of the U.S. Congress in the establishment and enforcement of radiation protection standards in the U.S.A. is reviewed, with emphasis on the role of the Joint Committee on Atomic Energy, the Federal Radiation Council, and the National Council on Radiation Protection and Measurements. (CH)

28599 (CONF-730907-P1, pp 214-224) BENEFITS AND RISKS TO NUCLEAR POWER IN THE UNITED STATES: AS LOW AS PRACTICABLE RADIATION DOSE PHILOSOPHY. Goldman, M. I. (NUS Corp., Rockville, MD). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Radiation protection standards in the USA are reviewed in relation to the effects of nuclear power plants on levels of radioactivity in the environment. It is suggested that radiation protection guidance for the nuclear power industry should be established on the basis of cost-benefit analysis, particularly taking into account the total biological and environmental risks of the various options available and the cost-effectiveness of reducing these risks. (CH)

Radiation Source Calibration and Standardization

28600 AMERICIUM-241 AS A LOW-ENERGY PHOTON INTENSITY STANDARD. Campbell, J. L.; McNelles, L. A. (Guelph Univ., Ontario (Canada). Dept. of Physics). Nucl. Instrum. Methods; 117: No. 2, 519-532(15 May 1974).

A new set of low-energy photon intensities per disintegration is obtained for ^{241}Am. This is based on relative intensity measurements with highly collimated Si(Li) and Ge(Li) detectors and on absolute measurements in the narrow energy region 13-16 keV. The results are compared in detail with other recent ^{241}Am data, in the context of their utility for efficiency calibration of Si(Li) X-ray detectors. (auth)

Shielding Calculations and Experiments

Refer also to abstract 28583.

PHYSICS (THEORETICAL)

General

Refer also to abstracts 26889 and 28316.

28601 SCHRÖDINGER EQUATION WITH INVERSE FOURTH-POWER POTENTIAL, A DIFFERENTIAL EQUATION WITH TWO IRREGULAR SINGULAR POINTS. Bühring, W. (Physikalisches Institut der Universität Heidelberg, Heidelberg, Germany). J. Math. Phys. (N.Y.) 15: No. 9, 1451-1459 (Sept 1974).

The Schrödinger radial equation with inverse fourth-power potential is treated analytically. Solutions in the form of integral representations of the generalized Laplace type are considered. Standard solutions are defined relative to each of the two irregular singular points of the differential equation. The coefficients in the linear relations persisting between any three of the standard solutions are obtained. The expressions for the coefficients, which contain some Taylor and Laurent series and finite determinants, are suitable for electronic computation. From the coefficients the S matrix and the scattering phase shifts may be obtained immediately. (auth)

28602 SYSTEM OF RADIATIVE TRANSFER EQUATIONS IN STRONG MAGNETIC FIELD. Rachkovskii, D. N. Izv. Krym. Astrofiz. Observ.; 49: 51-57(1974). (In Russian).

Absorption coefficients of a quantum oscillator in strong magnetic field is deduced. A system of radiative transfer equations is formed for Stokes parameter. (auth)

28603 NUMERICAL EVALUATION OF MANY-DIMENSIONAL INTEGRALS IN SOLUTIONS OF THE MOLECULAR SCHROEDINGER EQUATION. Boys, S. F.; Stanton, L. (Cambridge Univ., Eng.). Mol. Phys.; 28: No. 1, 225-241(Jul 1974).

A novel approach is described for the selection of spatial points and weights in a procedure for the evaluation of the many-dimensional integrals occurring in variational soltuions of the molecular Schroedinger equation. The procedure gives rise to a single numerical integration grid or mesh covering the whole molecule and avoids the use of different grids about different nuclear centers and the accompanying single-center weighting procedures of previous methods. Difficulties associated with integrating different size electronic shells on the same or different centers are also removed. The full theory of the method is described and practical computational procedures are given. Various integration tests were carried out, and the quality of the results is discussed in relation to analytical integrations and values obtained using an earlier numerical integration method. (auth)

28604 MODEL OF POINT DYNAMICS FOR WAVE MECHANICS. Cosma, Z. (Technical Univ., Budapest). Acta Chim. Acad. Sci. Hung.; 36: No. 2, 195-196(1974). (In French).

Starting from the Schroedinger equation the orbits are discussed for a model of point dynamics in quantum mechanics. (JFP)

28605 SOLUTION OF THE SCHRODINGER EQUATION IN TERMS OF CLASSICAL PATHS. Balian, R.; Bloch, C. (Service de Physique Théorique, Centre d'Etudes Nucléaires de Saclay, Gif-sur-Yette, France). Ann. Phys. (N.Y.) 85: No. 2, 514-545 (June 1974).

An expression in terms of classical paths is derived for the Laplace transform Ω (s) of the Green function G of the Schrödinger equation with respect to 1/h. For an analytic potential V(r), the function Ω is also analytic in the plane of the complex action variable s; its singularities lie at the values L of the action along each possible (complex) classical path, including the paths which reflect from singularities of the potential. Accordingly, G may be written as a sum of terms, each of which is associated with such a classical path, and contains the factor exp(iL/h). This expansion formally solves the problem of constructing waves out of the corresponding (complex) classical paths. A similar expression, in terms of closed paths, is derived for the density ρ of eigenvalues of the Schrödinger equation. In situations when the eigenvalues are dense, ρ is well approximated by the contributions of the shortest closed paths: while the path of vanishing length corresponds to the Thomas-Fermi approximation and its smooth corrections, the other paths yield contributions which oscillate and are damped as exp(iL/h). This result also holds for nonanalytic potentials V(r). If the spectrum is continuous, closed classical paths yield oscillations in the scattering phase-shift. The analysis is also extended to multicomponent wave functions (describing, e.g., motion of particles with spin, or coupled channel scattering); along a classical path, the internal degree of freedom varies adiabatically, except through points at which it is not coupled to the potential, where it may undergo discrete changes. (auth)

28606 THE MEAN OF SEVERAL QUOTIENTS OF TWO MEASURED VARIABLES. Bodek, A. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Nucl. Instrum. Methods; 117: No. 2, 613-616(15 May 1974).

It is shown that the weighted geometrical mean is a more correct estimate of the mean of several quotients of two measured variables when the variables are normally distributed and have comparable errors. (auth)

28607 COHERENT STATES AND UNCERTAINTY RELATIONS. Trifonov, D. A. (Institut po Yaderna Fizika i Yaderna Energetika, Sofia (Bulgaria)). Phys. Lett., A; 48: No. 3, 165-166(17 Jun 1974).

The most general form of the minimality-preserving Hamiltonians is found and the uncertainty products $\Delta q \Delta p$ are calculated for some quadratic quantum systems. (auth)

Quantum Field Theories

Refer also to abstracts 28059, 28218, 28256, and 28305.

28608 QUANTIZATION ON SPACETIME HYPERBOLOIDS. Sommerfield, C.M. (Sloane Physics Laboratory, Yale Univeristy, New Haven, Connecticut 06520). Ann. Phys. (N.Y.) 84: No. 1, 285-302 (15 May 1974).

A quantization scheme which specifies commutation relations on spacetime hyperboloids is examined and shown to lead to a Fock space different from the usual one. Nevertheless, the theories are shown to be physically equivalent if properly interpreted. (auth)

28609 REMARK ON THE EXISTENCE OF φ_4^4. Glimm, J. (Rockefeller University, New York, New York 10021); Jaffe, A. Phys. Rev. Lett. 33: No. 7, 440-442 (12 Aug 1974).

The bound $|S_\epsilon^{(2)}(f \otimes g)| \leq \text{const}|f|_S |g|_S$, uniform as the lattice spacing $\epsilon \to 0$, is sufficient to yield construction of a φ^4 field theory. In perturbation theory, this bound holds in space-time dimensions $d \leq 4$. The bounds on the n-point Schwinger functions follow from the given bound by the use of Lebowitz's inequalities. They yield the growth $|S^{(n)}| \leq O(n!)$, consistent with the Osterwalder-Schrader axioms, which allow reconstruction of a real-time theory. (auth)

28610 HIGH-DENSITY PHASE TRANSITIONS IN GAUGE THEORIES. Harrington, B.J.; Yildiz, A. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 33: No. 5, 324-327 (29 July 1974).

By the introduction of a chemical potential for an absolutely conserved fermion quantum number, we determine the onset of a phase transition in a general renormalizable, finite-temperature field theory with spontaneously broken symmetries. We also briefly investigate the possible physical existence of such a phase transition in black holes and in the early universe. (auth)

28611 QUANTUM FIELD THEORY MODELS WITH DERIVATIVE COUPLINGS AND ISOTOPIC SPIN. Tarski, J. (Univ., Hamburg). Acta Phys. Austr.; 38: No. 1, 55-61(Aug 1973).

Several two-dimensional models are discussed heuristically, and are suggested as subjects for investigation in the framework of constructive field theory. These models are nonsuperrenormalizable and also nontrivial. Furthermore, a class of renormalizable models with nonlocalizable solutions is noted. (auth)

28612 REDUCTION OF ELECTROMAGNETIC FIELDS FOR NON-ZERO MASS SYSTEM IN ANGULAR MOMENTUM BASIS. Rajput, B. S.; Parkash, O. (Kurukshetra Univ., India). Indian J. Phys.; 48: No. 3, 215-224(Mar 1974).

Commutation rules for the components of second quantized electromagnetic field operators for nonzero mass system are derived in linear momentum basis by using their reduced expansions in terms of irreducible representations of proper orthochronous, inhomogeneous Lorentz group, and it was shown that these rules are similar to those for zero-mass system. Reduced expansions for nonzero mass system in linear momentum basis were transformed to those in angular momentum basis and it was shown that the longitudinal magnetic field vanishes for nonzero mass system also, while longitudinal electric field never vanishes. (auth)

28613 DEVELOPMENT OF QUANTUM FIELD THEORY. Segal, I. (Massachusetts Inst. of Tech., Cambridge). pp 395-435 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

Recent developments on the foundations of quantum field theory are reviewed. The topics discussed include the abstract algebraic approach, the mathematical development of the wave-particle

duality, hyperbolicity of quantized partial differential equations, the meaning of nonlinear equations of motion and the interaction Hamiltonian as a generalized operator in a Hilbert space. In this last context the problems which arise if one requires the interaction Hamiltonian to be defined at a sharp time is discussed. It is emphasized that although this can be done in lower-dimensional space-time, a modification is likely to be required in four-dimensional space-time. Examples of such "distribution" propagators which allow a well defined interaction representation are given. (auth)

28614 ACTION AT A DISTANCE. Sudarshan, E. C. G. (Univ. of Texas, Austin). pp 519-560 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

The historical development of "action-at-a-distance" theories is reviewed. The formulation of classical action-at-a-distance theories is reviewed, and the relevant conserved quantities identified. This theory is compared with a corresponding classical field theory. The lessons of this classical theory are applied to the formulation of a quantum theory of action-at-a-distance. The problem of unitarity and physical interpretation are described. The relation with indefinite metric theories of elementary particles is clarified, and finally a theory of interactions which includes self interaction but contains only finite computations is formulated. (auth)

28615 HEADLIGHTS OF THE LAST DECADE IN FIELD THEORY. Klauder, J. R. (Bell Telephone Labs., Inc., Murray Hill, NJ). pp 561-598 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

Three main parts are considered: one dealing with the connection of the axiomatic approach to scattering theory, a second dealing with the advances in algebraic quantum theory and a third dealing with constructive field theory. In the first part Wightman's reconstruction theorem and its consequences are emphasized. The relation between the asymptotic conditions and the test function spaces in the Haag–Ruelle and LSZ-theories respectively is treated in some detail. Other topics commented upon in this part are conditions on the Lehmann spectral function which reduce the theory to a theory of generalized free fields, and Borchers' results on the equivalence classes of local fields. In the second part the Gelfand–Naimark–Segal construction is described. The consequences of the weaker, physical, criterion for equivalence between representations of an algebra of measurable operators is discussed, together with the question of implementing automorphisms of an algebra by unitary transformations. In the third part the main attention is given to the limiting problems involved in the removal of spatial cut-offs. The recent results concerning explicit models, mainly in two-dimensional space-time, are reviewed. The talk concludes with some remarks on a theorem on the anti-commutation relation. (auth)

28616 RELATIVITY AND QUANTUM MECHANICS. Dirac, P. A. M. (Florida State Univ., Tallahassee). pp 747-772 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

The subjects of relativity and quantum mechanics are considered from the author's own point of view including the proper opinion with regard to the difficulties. It is concluded that the changes which are needed to avoid the present difficulties facing quantum theory and appearing as a resistance between the quantum theory and relativity will be very drastic as was the change from Bohr orbits to quantum mechanics. (JFP)

28617 GAUGE FIELD THEORIES. Veltman, M. (CERN, Geneva). pp 429-447 of Proceedings of the 6th International Symposium on Electron and Photon Interactions at High Energies. Pfeil, W. (ed.). New York; American Elsevier Publishing Co., Inc. (1974).

From sixth international symposium on electron and photon international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973). See CONF-730842-.

A brief account is given of the development of an argument in favor of a gauge field theory of strong interactions. The question of higher order effects is then considered. The renormalization program and the associated problems are then outlined. Kibble's method is used to define the physical particles. The question of the validity of PCAC and low-energy theorems is considered. A historical review and bibliography are given in the appendix. (LBS)

28618 FREDHOLM APPROXIMATIONS IN THE SCALAR BETHE-SALPETER EQUATION. Bauhoff, W. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Naturforsch., a; 29: No. 6, 916-923(Jun 1974).

2 figs.; 1 tab.; 17 refs.

The Fredholm approximation is discussed in the framework of the scalar Bethe-Salpeter equation. The trace of the angular momentum decomposed kernel is expressed in terms of Feynman parameter integrals which shows the relation to the vertex function. A new derivation for this representation is given which is far more direct than the previous one. Using this representation, several general features of the eigenvalues are discussed. For special cases, the trace is computed explicitly, and the numerical values are compared with the exact ones, obtained by variational methods. (auth)

28619 STRONG-COUPLING LIMIT OF REGGE TRAJECTORIES IN THE ϕ^3 LADDER MODEL. Miller, R. L. (Univ. of Illinois, Urbana). Phys. Rev., D; 9: No. 10, 2840-2846(15 May 1974).

A technique is extended to $t \neq 0$ employing the Bethe-Salpeter equation, developed by Chang and Rosner to study the strong-coupling limits of ladder-graph models. One can calculate the first nontrivial t-dependent term in the trajectory function $\alpha(t)$ for ϕ^3 theory. The behavior of $\alpha(t)$ depends upon whether the exchanged particle is massless. It is also indicated how daughter trajectories may be calculated. (auth)

28620 QUANTIZATION OF A FIELD WITH MASS IN TWO-DIMENSIONAL EUCLIDEAN SPACE. di Sessa, A. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 9: No. 10, 2926-2932(15 May 1974).

As an example of a new approach to field theory scalar and spinor massive free fields are quantized in two-dimensional Euclidean space. Two appropriate conjugate spaces are generated to replace momentum space. The massless limits of the field theories are discussed. (auth)

28621 REGGEIZATION OF ELEMENTARY PARTICLES IN RENORMALIZABLE GAUGE THEORIES: SCALARS. Grisaru, M. T.; Schnitzer, H. J.; Tsao, H. S. (Brandeis Univ., Waltham, MA). Phys. Rev., D; 9: No. 10, 2864-2873(15 May 1974).

The question of the Reggeization of the elementary particles in gauge theories with a spontaneously broken symmetry is extended to examination of the scalar-meson states of these theories. Owing to the complexity of the problem, the study is limited to three typical gauge models, U(1), SU(2), and U(2). It is demonstrated that under special circumstances the Born approximation for some or all of the $J = 0$ amplitudes can be factorized, the first time the possible Reggeization of elementary scalars was reported. However, no model is found in which all elementary particles lie on Regge trajectories. The crucial role of an Abelian vector meson, which does not Reggeize, and a fermion, which does, is emphasized. Since the Mandelstam counting argument is inconclusive at $J = 0$, the conclusions are limited to lowest order in perturbation theory. (auth)

28622 STUDY OF RENORMALIZATION COUNTER TERMS IN GAUGE THEORIES. Yang, T. C. (California Univ., La Jolla, San Diego (USA). Dept. of Physics). Nucl. Phys., B; 74: No. 3, 541-547(4 Jun 1974).

Theories with spontaneous broken gauge symmetry will have pseudo-Goldstone bosons, if the scalar multiplets are unlocked. Locking or unlocking of representations is best suited by the renormalization counter terms for general group representations. Renormalizability of the theory with less than complete terms (of dimension ≤ 4) allowed by gauge symmetry in the scalar polynomial is also studied. (auth)

28623 A SIMPLE FORMULA FOR CALCULATING QUANTAL EXPECTATION VALUES WITHOUT THE USE OF WAVE FUNCTIONS. Froeman, N. (Uppsala Univ. (Sweden)). Phys. Lett., A; 48: No. 2, 137-139(3 Jun 1974).

A simple formula for the calculation of quantal expectation values for bound states in a single-well potential, is derived. The expectation values are obtained to within the accuracy corresponding to any conveniently chosen order of a certain kind of phase-integral approximations. (auth)

Gravitation and General Relativity

Refer also to abstracts 28230 and 28608.

28624 (AD-773179) STUDIES IN GRAVITATIONAL THEORY. Final Technical Report, 1 November 1969–31 October 1972.

Goldberg, J. N. (Syracuse Univ., N. Y. (USA). Dept. of Physics). Nov 1973. Contract F33615-70-C-1111. 18p. (ARL-73-151). NTIS $3.00.

The research described in the report is concerned with the Newman-Penrose constants, conservation laws, equations of motion, and quantization of general relativity. In most of these topics the use of null coordinates plays an essential role. Quantization is discussed in terms of null surfaces and in terms of space-like surfaces. The introduction of twisters is presented at length and their possible relationship to a quantum theory of gravitation is discussed briefly. (auth)

28625 SPECIAL RELATIVITY IN GENERAL RELATIVITY? Hirondel, D. (Department of Physics, University of Delaware, Newark, Delaware). J. Math. Phys. (N.Y.) 15: No. 9, 1471-1473 (Sept 1974).

Starting from the metric in harmonic coordinates for a test particle m_1 around a heavy particle $m_2(m_2 \gg m_1)$ at rest, the EIH Lagrangian is recovered by making a Lorentz transformation, followed by a canonical transformation and an appropriate symmetrization in the two masses. This raises the question of a special relativity content in general relativity, a feature not directly implied by the general covariance. (auth)

28626 WEAK GRAVITATIONAL FIELDS. Lerner, D.; Porter, J.R. (Department of Mathematics, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). J. Math. Phys. (N.Y.) 15: No. 9, 1413-1415 (Sept 1974).

We consider the set of C^k bounded tensor fields of type (r,s) on R^4 in the topology of uniform C^k convergence. For each $k \geq 2$, the map sending a metric to its curvature tensor is shown to be analytic at the Minkowski metric. The same is true of the map sending a metric to its Einstein tensor. The well-known linearized theory of gravitation amounts to studying the directional derivatives of these maps. An iterative method for solving the full field equations along an analytic curve of Einstein tensors passing through zero is proposed. (auth)

28627 CAN OUTSIDE FIELDS DESTROY BLACK HOLES?. Petr Hájiček (Institute for Theoretical Physics, University of Berne, Switzerland). J. Math. Phys. (N.Y.) 15: No. 9, 1554-1558 (Sept 1974).

Stationary, axisymmetric, asymptotically flat space-times with a black hole surrounded by matter rings, disks, or shells are considered. A certain set of invariant functions, called local invariants, is defined which contains full information about the metric and electromagnetic field in a small electrovacuum neighborhood of the horizon. The local invariants are shown to satisfy an inequality, which is a generalization of the well-known Kerr-Newman inequality $m^2 > a^2 + e^2$, and which places an upper bound on the gravimagnetic, electric, and magnetic field strengths as measured at the surface of the black hole, independently of whether the fields are produced by the black hole itself or originate in outside sources. (auth)

28628 COMPLEX STRUCTURES AND REPRESENTATIONS OF THE EINSTEIN EQUATIONS. Brans, C.H. (Joseph Henry Laboratories, Physics Department, Princeton University, Princeton, New Jersey 08540). J. Math. Phys. (N.Y.) 15: No. 9, 1559-1566 (Sept 1974).

The space-time model of general relativity is that of a four-dimensional manifold M, with a metric of Minkowski signature. The space of two-forms on M is endowed with a natural complex structure, J, generated by the star duality operator. The existence of such a structure is an accidental characteristic of the dimension four and of the metric signature. The full differential geometric structure equations are expressed in this two-form language, and it is pointed out that the weakened Einstein empty space equations, i.e., $R_{ab} - (1/4)g_{ab}R = 0$, reduce to the condition that the curvature form commute with J. This fact, together with the isomorphism of the two-form space with the Lorentz Lie algebra, l_0, are then shown to provide the basis for the importance of the various complex representations of l_0, such as SO(3,C) and the spinor SL(2,C), in understanding the real geometry of Einstein spaces. In fact, the complexified Einstein structure equations naturally divide into two sets, each the complex conjugate of the other, each involving only one-half of the basis. (auth)

28629 ASYMPTOTICALLY SIMPLE SPACE-TIME MANIFOLDS. Lerner, D.; Porter, J.R. (Department of Mathematics, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). J. Math. Phys. (N.Y.) 15: No. 9, 1416-1419 (Sept 1974).

Asymptotically simplicity is shown to be k-stable ($k \geq 3$) at any Minkowski metric on R^4 in both the Whitney fine C^k topology and a coarser topology (in which the C^k twice-convariant symmetric tensors form a Banach manifold whose connected components consist of tensor fields asymptotic to one another at null infinity). This result, together with a sequential method for solving the field equations previously proposed by the authors, allows a fairly straightforward proof that a well-known result in the linearized theory holds in the full nonlinear theory as well: There are no nontrivial (i.e., non-Minkowskian) asymptotically simple vacuum metrics on R^4 whose conformal curvature tensors result from prescribing zero initial data on past null infinity. (auth)

28630 COMPLEX POTENTIAL FORMULATION OF THE AXIALLY SYMMETRIC GRAVITATIONAL FIELD PROBLEM. Ernst, F.J. (Department of Physics, Illinois Institute of Technology, Chicago, Illinois 60616). J. Math. Phys. (N.Y.) 15: No. 9, 1409-1412 (Sept 1974).

Spin-coefficients and null tetrad components of the Ricci tensor and the Weyl conform tensor are evaluated in terms of a single complex gravitational potential ϵ, while null tetrad components of the electromagnetic stress energy tensor are evaluated in terms of a second complex potential Φ. All the results are expressed elegantly in terms of a differential operator δ similar to the "thop" of Newman and Penrose. The problem of finding physically pertinent stationary axially symmetric Einstein-Maxwell fields is reduced to the search for a complex solution $\xi_0(x, y)$ of one nonlinear differential equation subject to simple subsidiary conditions. (auth)

28631 LOCAL SCALE INVARIANCE AND GRAVITATION. Freund, P.G.O. (The Enrico Fermi Institute and the Department of Physics, The University of Chicago, Chicago, Illinois 60637). Ann. Phys. (N.Y.) 84: No. 1, 440-454 (15 May 1974).

A gauge field theory of (local) scale invariance is constructed. When coupled to gravity, it yields the old theory of Weyl. A Brans-Dicke scalar field is introduced á la Dirac. With a suitable choice of parameters the theory then reduces in a special gauge to Einstein's theory even in the presence of matter. If the gauge field of scaling (even under charge conjugation) is identified with the gauge field of an internal symmetry, a (spontaneous) breakdown of charge conjugation invariance (and of CP) can follow. This effect has a reasonable order of magnitude if gravity is replaced by strong gravity and the internal charge identified with lepton number of baryon number, or some neutral weak charge. Certain difficulties arise, however, if one insists on the Weyl identification of the gauge field of scaling with the electromagnetic field. It is shown that the observed tensor mesons (f,f', etc.), while basic in tensor meson dominance, are not the quanta of a gauge field of strong gravity. (auth)

28632 REMARKS ON DIRAC'S NEW THEORY. Pietenpol, J.L.; Incoul, R.; Speiser, D. (Institut de Physique Théorique, Unitersité Catholique de Louvain, B-1348 Louvain-la-Neuve, Belgium). Phys. Rev. Lett. 33: No. 6, 387-388 (5 Aug 1974).

We show that Dirac's proposed scalar-tensor theory of gravitation and electromagnetism can be rewritten in such a way that the scalar field decouples from the rest of the world. The symmetry breaking implicit in the formalism is shown to be unobservable. (auth)

28633 INTEGRAL FORMALISM FOR GAUGE FIELDS. Yang, C. N. (Institute of Theoretical Physics, University of Wrocław, Wrocław, Poland). Phys. Rev. Lett. 33: No. 7, 445-447 (12 Aug 1974).

A new integral formalism for gauge fields is described. Further developments are presented, including gravitation equations related to, but not identical with, Einstein's equations. (auth)

28634 A THEORY OF GRAVITATION. Rosen, N. (Department of Physics, Technion-Israel Institute of Technology, Haifa, Israel). Ann. Phys. (N.Y.) 84: No. 1, 455-473 (15 May 1974).

A theory of gravitation is presented satisfying the covariance and equivalence principles. It makes use of a Riemannian metric tensor $g_{\mu\nu}$, describing the true gravitational field, and a flat-space metric tensor $\gamma_{\mu\nu}$, describing the inertial forces. The field equations have a simple structure so that, for a given $\gamma_{\mu\nu}$, the initial conditions, which are not subject to any constraints, completely determine the solution. The theory gives results in agreement with those of the general relativity theory to the accuracy corresponding to observations at the present time. The static spherically symmetric solution for the field of a point mass has a singularity only at the point, without any "black hole." (auth)

28635 MONOTONIC EVOLUTION OF BOLTZMANN'S H IN WEAKLY COUPLED GRAVITATIONAL SYSTEM. Haggerty, M. G. (Univ. of Texas, Austin); Severne, G. Nature (London); 249: No. 5457, 537-538 (7 Jun 1974).

It is stated that gases with gravitational interactions are expected to evolve away from a state of uniform density and temperature, and that such behaviour was confirmed by experimental work on small gravitational systems. A discussion is presented on such an evolution, in terms of the Boltzmann constant H. (UK)

28636 SOME NUMERICAL RESULTS OF THE INVERSE GRAVITY PROBLEM SOLUTION WITH A FINITE NUMBER OF ELEMENTARY SOURCES. Zhelev, Z. P. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 6, 791-794 (1974).

The Marquardt method is used to solve an inverse gravimetric problem with a finite number of elementary sources. It is concluded that this method gives very good results especially

in the singular case when solving an inverse gravity problem with point masses and that it can be used in combination with the sweeping-out method in the interpretation of real geophysical observations. (JFP)

28637 BREAKING OF CONFORMAL SYMMETRY AND RENORMALIZATION OF NON-POLYNOMIAL THEORIES. Salam, A. (Imperial Coll. of Science and Tech., London). pp 1-32 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

The nonlinear realizations of the conformal group and the group of general relativity are discussed. The general problem of nonpolynomial Lagrangians is reviewed. In particular the nonpolynomial, nonlinear Lagrangian theories do not appear to suffer from the ultraviolet infinities of the usual polynomial Lagrangian theories. The relativistic theory of gravitation is included in this discussion of nonlinear nonpolynomial theories since, when this theory is taken into account as a quantum theory, it appears possible that all infinities still surviving in renormalized theories like quantum electrodynamics will disappear. Explicit calculations with models do show this result. A discussion of this talk is given. (auth)

28638 GRAVITATION AND PARTICLE PHYSICS. Deser, S. (Brandeis Univ., Waltham, MA). pp 599-636 of Past Decade in Particle Theory. Sudarshan, E. C. G. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From symposium on the past decade in particle theory; Austin, Texas, USA (14 Apr 1970). See CONF-700424-.

A discussion is given of the significance and status of general relativity in terms of the concepts of particle physics. General relativity as self-coupling and quantization and relations to particle physics are considered. (JFP)

28639 EXTERNAL FIELDS IN GRAVITATIONAL COLLAPSE OF ROTATING MASSES. Khar'kov, A. A. Zh. Eksp. Teor. Fiz.; 66: No. 5, 1505-1514(May 1974). (In Russian).

The behavior of electromagnetic and gravitational fields in the rotating black hole metrics is investigated. It is shown that rotation leads to $2l + 1$ multiple splitting of frequency of the l^{th} spherical field harmonic. Moreover, in the case of an electromagnetic field "oblique terms" of the metric lead to the appearance of both "electric" and "magnetic" components of the electromagnetic field, irrespective of nature of the source. In this case the invariant $(EH) \neq 0$. It is shown that the damping laws for external fields produced by a rotating collapsing mass as well as the "tails" of wave packets moving in the metric of a rotating black hole have a form which is the same as that in the absence of rotation. (auth)

28640 ELECTROMAGNETIC RADIATION OF A CHARGE IN A KERR FIELD. Ternov, I. M.; Khalilov, V. R.; Chizhov, G. A.; Maglevannyi, I. I. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 19: No. 8, 267-269(20 Apr 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 8, 503-507(20 Apr 1974).

A detailed analysis is presented of the properties of the electromagnetic radiation coming from a charge moving along a circular geodesic line in the equatorial plane of a Kerr field. At certain values of the parameters, the results are applicable to a Schwarzschild field. (auth)

28641 GENERALIZED STATIC ELECTROMAGNETIC FIELDS IN RELATIVITY. Teixeira, A.F.d.F.; Wolk, I.; Som, M.M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro ZC-82, Brazil). J. Math. Phys. (N.Y.) 15: No. 10, 1756-1759 (Oct 1974).

A general class of static cylindrically symmetric solutions of the Einstein-Maxwell equations coupled with a zero-rest-mass scalar field is obtained under the assumption $-r^2 g_{rr} = g_{00} g_{44} g_{zz}$. These solutions reduce to Marder's well-known exterior solution in the absence of electromagnetic and scalar fields. (auth)

28642 WHITEHEAD CONTRA EINSTEIN. Reinhardt, M. (Bonn Univ. (F. R. Germany). Astronomische Institute); Rosenblum, A. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Phys. Lett., A; 48: No. 2, 115-116 (3 Jun 1974).

None of the classical tests of general relativity can distinguish between Einstein's and Whitehead's theories of gravitation. Claims that geophysical effects exclude Whitehead's theory are shown to be unsubstantiated. Thus Whitehead's theory proves to be one of the so far undefeated rivals of general relativity. A feasible experimentum crucis is delineated. (auth)

REACTOR TECHNOLOGY AND REGULATION

28643 THE 6TH REACTOR MEETING IN BERLIN. Lenz, W. Tech. Ueberwach.; 15: No. 7, 256-258(Jul 1974). (In German).

A report on the 6th Reactor Meeting, held from April 2-5, 1974 in Berlin is given. The main topics of the meeting were the safety of nuclear power plants, the reprocessing of spent fuel elements with the treatment of their highly radioactive fission products, and problems concerning the further development of fast breeders and high-temperature reactors. (GE)

28644 OPERATING EXPERIENCE WITH NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Annual Report 1973 of the ABE-Committee in the Working Group I "Engineering and Industry" of Deutsches Atomforum e.V. At. Strom; 20: No. 5/6, 41-63(May 1974). (In German).

With figs.

The operational results of the year 1973 of the nuclear power plants operated in the Federal Republic of Germany are summarized. The individual nuclear power plants are dealt with in separate sections. The particular events of the year are explained by means of operational diagrams. (GE)

28645 NUCLEAR POWER IS THE SOLE ALTERNATIVE TO MINERAL OIL. Wuest, H. F. Energ. Tech.; 26: No. 6, 145-149(Jun 1974). (In German).

A summarizing report on the lectures of the 1974 Reactor Meeting is given. (GE)

28646 VIEW OF THE NUCLEAR POWER DEVELOPMENT. Wada, F. (Ministry of International Trade and Industry, Tokyo). Karyoku Genshiryoku Hatsuden; 24: No. 5, 446-453(May 1973). (In Japanese).

In 1985, the capacity of nuclear power generation in Japan is expected to reach the level of about 60,000,000 kW. Nuclear power generation in the future, particularly in Japan, is described in the following: the necessity of the nuclear power generation and its future scale; the present status of light-water reactors and the future prospects; other types of reactors (AGR, HTGR, heavy-water reactors, and FBR); and future problems in nuclear power generation. In Japan, nuclear power generation is mostly by the light-water type reactors, and its future economic aspect is brighter than thermal power plants because of technological development. The respective reatures of other type reactors are pointed out. The future problem of nuclear power generation is centered in securing the sites for power plants. (JA)

28647 PLANS FOR CONSTRUCTION OF NUCLEAR POWER PLANTS AND THE PAST RECORDS OF NUCLEAR POWER PLANT OPERATION. Karyoku Genshiryoku Hatsuden; 24: No. 5, 491-515 (May 1973). (In Japanese).

Concerning nuclear power generation in Japan, the following are presented in the form of tables. (1) Plans for construction of nuclear power plants. By the end of fiscal 1981, the capacity of nuclear power generation will be 37,661 MW. (2) Outline of nuclear power plants existing and under construction. (3) Operation records of the existing power plants (total of six plants). (4) Drawings of the nuclear power plants existing and under construction. (5) Overseas development of nuclear power generation. (JA)

28648 DEEPWATER SITING OF FLOATING NUCLEAR POWER PLANTS. Hammond, R. P. (Oak Ridge National Lab., TN); Okrent, D. *Ann. Nucl. Sci. Eng.*; 1: No. 2, 129-138(Feb 1974).

Depth restriction, cost, and environmental impact of large fixed breakwaters are a major restriction on the applicability of floating nuclear power stations. Deepwater versions without breakwater were found by a university-industry study team to be technically feasible if technology developed for offshore oil production is applied. Barges and mooring systems capable of withstanding maximum Pacific Coast sea conditions seemed feasible, and the expected barge motions and accelerations were found to be within the range for which even land-based plants are designed. Safety from ship collision was achieved by a new concept which intercepts and halts an approaching ship without damage or spillage of its cargo. Important legal, safety, and environmental considerations in siting offshore power stations were studied. (auth)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 28721, 28744, 28747, 28750, 28756, 28761, 28763, and 28769.

28649 (CONF-730907-P2, pp 799-809) OPERATIONAL HEALTH PHYSICS DURING DISMANTLING OF THE ELK RIVER REACTOR. McConnon, D. (United Power Association, Elk River, MN). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The Elk River Reactor (ERR), a 58 MW(t) boiling water reactor, was operated for four years and shut down in 1968 for economic reasons. The facility is now being dismantled such that the reactor site will be returned to approximately the condition that existed prior to installation of the reactor with all vestiges of the reactor plant (except for subgrade foundations) having been removed and disposed of. This is the first time that decommissioning of a power reactor has involved complete removal and disposal of large radioactive structures, rather than in-place entombment. Removal operations and radiological conditions during dismantling of the highly radioactive portions of the reactor are described. The removal sequence of these structures started with the reactor internals and inner thermal shield, progressed through the pressure vessel and outer thermal shield and ended with the inner sections of the biological shield. Segmentation of the structures, either by mechanical or hot-cutting techniques, and packaging for transportation were done remotely to control personnel exposure with the addition, at times, of temporary shielding. To prevent the spread of contamination to work areas, operations were carried out underwater, or where this was not possible, in a specially designed containment structure around the work area. (auth)

28650 (JAERI-M-5478) VIBRATIONS OF JPDR-II FUEL ROD INDUCED BY COOLANT FLOW. Okazaki, M.; Yamazaki, Y. (Japan Atomic Energy Research Inst., Tokyo). Dec 1973. 88p. (In Japanese). NTIS (US Sales Only).

The vibration of JPDR-II fuel rods induced by coolant flow was measured with a dummy fuel assembly in water and air–water two-phase flow at room temperature and atmospheric pressure. The instrumented dummy fuel rods of the same stiffness, weight per unit length and dimensional tolerance as the actual ones were installed at three typical positions in the fuel assembly. At the center of the span between two spacers, four semi-conductor strain gauges were attached on to the inside of the cladding tube to measure the frequency and amplitude of vibration. In the power spectra of rod vibration frequency four prominent peaks are observed, i.e. a peak at 8–12 Hz corresponding to the natural frequency of the assembly and three peaks at 43 Hz, 56 Hz and 76 Hz considered to be natural frequency of the span between the spacers. For the span of 540 mm, the RMS values of amplitude (corresponding to the half of peak to peak amplitude) of vibration are 0.03 mm at 80 t/h water flow and 0.2 mm in air–water two-phase flow of 60% void fraction. In two-phase flow the amplitude depends mainly on the void fraction in contrast to the single-phase flow case where it depends on the water flow rate. Probability density and probability distribution of the amplitude were also measured. The amplitude predicted by the correlations of Burgreen, Paidoussis and of Reavis is remarkably smaller than the experimental ones. Examination of the correlations revealed that the discrepancies derived from the inadequate simulation of fuel rods and flow path. (auth)

28651 (ORNL-TM-3373) QUALITY ASSURANCE PROGRAM PLAN. Intermediate Vessel Test Facility (HSST Program). Derby, R. W.; Segaser, C. L. (Oak Ridge National Lab., Tenn. (USA)). May 1971. Contract W-7405-eng-26. 41p. Dep. NTIS $5.25.

A Quality Assurance Program Plan is presented for use by the Reactor Division of the Oak Ridge National Laboratory in the design, construction, and operation of the Intermediate Vessel Test in support of the Heavy Section Steel Technology Program. The plan sets forth requirements, policies, and procedures for planning, managing, conducting, and evaluating processes, structures, components, and systems. Quality assurance procedures based on proven practices covering management and planning, design and development, procurement, fabrication and assembly, installation, operation, maintenance, modifications, and audit are included. (auth)

28652 AUXILIARY PUMPS FOR THE PRIMARY CIRCUIT OF AN 800 MW(e) BWR. Laux, C. H. (Sulzer Bros. Ltd., Winterthur, Switzerland). Nucl. Eng. Int.; 19: No. 218, 585-589(Jul 1974).

The auxiliary pumps used for the safety of reactor cooling in

both the emergency core cooling and the after-cooling systems are described. These include the high-pressure coolant injection pump in the emergency core cooling system, the reactor core isolation cooling pump for use in case of a steam pipe break outside the containment, core spray pumps automatically acting when the pressure in the reactor drops to about 19 atm abs., and the residual heat removal pump employed in the low pressure range during normal operation. Features discussed are design, materials, mechanical seals, bearings, pump motors and acceptance testing. (UK)

28653 CHARCOAL-BED TYPE RARE GAS HOLD-UP SYSTEM IN THE TSURUGA NUCLEAR POWER STATION. Tanimura, K. (Japan Atomic Power Co., Tokyo). Karyoku Genshiryoku Hatsuden; 24: No. 4, 368-374(Apr 1973). (In Japanese).

A rare gas hold-up system was installed in the nuclear power plant (BWR with output 357 MWe) of JAPC's Tsuruga power station in December 1971, to reduce radioactivity of the rare gases released; and it has been in satisfactory operation ever since. The system consists of two front dehumidifiers (one as a stand-by), two sand filters, three rear dehumidifiers, eight adsorption towers, two exhaust gas filters, and two exhaust gas extractors (one as a stand-by). Specifications of the system are active-carbon type, flow rate 20 Nm^3/h, hold-up time 20 days, negative system pressure, and 4 ~ 6 mesh active carbon. (JA)

28654 BWR NUCLEAR POWER STATION. Ashiwara, E. (Tokyo Shibaura Electric Co. Ltd., Kanagawa, Japan); Korei, Y. Karyoku Genshiryoku Hatsuden; 24: No. 5, 469-483(May 1973). (In Japanese).

BWR-4 power stations, many of which are now under construction in Japan, are described. The design parameters and structure of reactor cores and fuel elements are shown. The average burnup of first core fuel is about 21,000 MWD/T, and that of equilibrium cores is about 27,500 MWD/T. The maximum permissible linear heat rate is 60.7 kw/m, and the minimum critical heat flux ratio is 1.9. Pressure vessels are designed so that the irradiation of fast neutrons does not exceed 10^{19} during the lifetime (40 years) of the plants. The outline of steam separators and dryers is also given. The weight percent of water contained in steam is below 0.1%. Other components of plants, such as reactor containments, emergency core cooling systems, turbine generators, and instrumentation and control systems are explained. Radioactive waste disposal systems are explained with emphasis on the effectiveness of the charcoal hold-up system. The progress of BWR design up to BWR-6 is reviewed, and main design parameters of typical plants are compared. The change in coolant cycle, power density, ECCS and reactor containment system are explained. (JA)

28655 DEACTIVATION OF RADIOACTIVE OFF-GASES FROM A SINGLE-LOOP BOILING-WATER REACTOR POWER PLANT BY EXPOSURE IN A CIRCULATION TUBE. Chukhlov, G. Z.; Yakshin, E. K.; Chechetkin, Yu. V.; Solov'ev, Yu. A. Sov. At. Energy (Engl. Transl.); 34: No. 5, 478-479(May 1973).

Translated from At. Energ. (USSR); 34: No. 5, 392(May 1973). *This is a summary of paper No. 665/5780 with full copy held at* TIC.

In cases where the pressure seal of fuel elements breaks down, *radioactivity carried by off-gases in a nuclear power station* based on a boiling-water reactor can attain levels of ~100 Ci/(days MW). Exposure of these gases in a circulation tube prior to venting them to the atmosphere can result in a twofold to *seventy-fold reduction in the activity. Equations for calculating* the required tube volume and the recommended exposure time for the gas are given. (LK)

28656 COMPARATIVE STUDY ON Pu-RECYCLING ON THORIUM BASIS IN BOILING WATER REACTORS. Spierling, H.; Stein, H. (Kraftwerk Union A. G., Frankfurt am Main (F. R. Germany)). Atomwirt., Atomtech.; 19: No. 6, 300-301(Jan 1974). (In German).

3 figs.

The physical properties of an uranium fuel element, U/Pu-fuel element and a Pu/Th fuel element are compared and the possibilities of Pu-recycling on thorium basis are studied. (GE)

28657 VGB SPECIFICATIONS FOR THE WATER IN NUCLEAR POWER PLANTS WITH LIGHT WATER REACTORS. Schroeder, H. J. (Rheinisch-Westfaelisches Elektrizitaetswerk A. G., Biblis (F. R. Germany). Betriebsverwaltung); Freier, R. K. (Hamburgische Electricitaets-Werke A. G. (F. R. Germany). Abt. Chemie und Physik); Hepp, H. (Preussische Elektrizitaets-A. G. (Preussenelektra), Wuergassen (F. R. Germany). Kernkraftwerk). VGB Kraftwerkstechnik; 54: No. 5, 319-324(May 1974). (In German).

3 figs.; 6 tabs.; 6 refs.

The standard values are based on the current state of knowledge, on currently normal designs, and on metallic materials normally used at the present time in nuclear power station construction. Apart from the bases for the individual standard values an illustration is given of the difficulties in discussing the values. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 28651, 28657, 28721, 28740, 28742–28744, 28750, 28752, 28753, 28758, 28759, 28762, 28763, 28818–28820, and 28822.

28658 (CONF-741017-1) ANALYSIS OF NEUTRON-DENSITY OSCILLATIONS RESULTING FROM CORE BARREL MOTION IN A PWR NUCLEAR POWER PLANT. Fry, F. N.; Kryter, R. C.; Robinson, J. C. (Oak Ridge National Lab., Tenn. (USA)). 1974. 5p.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

Abnormal ex-core detector flux oscillations at the Palisades-1 Reactor were analyzed with the aid of a computer-based noise analyzer and were attributed to changes in neutron leakage caused by a rocking motion of the core barrel and core inside the pressure vessel. Subsequent visual inspection of the core internals substantiated this diagnosis. (DG)

28659 (WAPD-MRP-142) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, January 26, 1974–July 25, 1974. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). 1974. Contract AT(36-1)-Gen-14. 16p. Dep. NTIS $4.00.

Plant operations and testing of the Shippingport PWR Core 2, Seed 2 continued with three reactor coolant loops in service and the 1A reactor coolant loop isolated until February 4, 1974, at which time the reactor was shutdown because of a failure of the main unit turbine generator. At the time of the shutdown, PWR Core 2, Seed 2 had been operated for a total of 10,160 equivalent full power hours. Inspections performed to date indicate that significant damage resulting from the turbine generator failure was limited to the turbine generator and auxiliary equipment, with only minor damage to the insulation on the main steam system piping and no damage to the reactor portion of the plant. An evaluation of the scope of repair work required to return the turbine generator to service indicated an extended shutdown will be required to complete the repairs. Because of this and because PWR Core 2, Seed 2 had met all of its design objectives, a decision was reached to terminate any further operation of the core and to proceed with defueling in preparation for planned installation of the LWBR demonstration core. A number of improvements related to the Radioactive Waste Disposal System have been completed or are in progress. One improvement being evaluated involves system modifications to permit processed radioactive water to be recycled back to the reactor primary system as make-up water. (auth)

28660 *(WCAP-7921-AR) DAMPING VALUES OF NUCLEAR* POWER PLANT COMPONENTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). May 1974. 89p.

Damping values and data from various tests of nuclear power plant components and other structures are presented and evaluated. A description of the damping determinations is given along with *recommended damping values for primary coolant loop components,* piping and other structures. The results show that, in general, damping increases with the magnitude of excitation and the resulting stress levels. It is shown that system damping, which is considered as the predominant damping mechanism for primary coolant loop components, yields damping values higher than those being currently used. (30 references) (auth)

28661 (WCAP-8359) EFFECTS OF FUEL DENSIFICATION POWER SPIKES ON CLAD THERMAL TRANSIENTS. Hellman, J. M.; Olson, C. A.; Yang, J. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Jul 1974. 35p.

The application of the Westinghouse power spike model to the analysis of clad temperatures during a transient, the postulated Loss-of-Coolant Accident (LOCA), is presented. (7 references) (auth)

28662 MAJOR POWER REACTORS. PWR System Nuclear Power Station. Aoki, I.; Kitamura, T. (Mitsubishi Heavy Industries, Ltd., Tokyo). Karyoku Genshiryoku Hatsuden; 24: No. 5, 454-468(May 1973). (In Japanese).

Nuclear power stations with pressurized water reactors are reviewed on their structure, characteristics, and performance. Nuclear power stations of this type are composed of steam gener-

ating equipment and turbine equipment. The steam generating equipment transfers the heat generated in the nuclear reactors to steam generators and generate the saturated steam with no radiation. The turbine generators generate electric power, being driven by the saturated steam. In such a manner, the primary cooling system and secondary system are completely separated by the steam generators, so that no radiation is characteristic of the saturated steam from the steam generators. In the reactor core, the fuel assemblies containing uranium oxide pellets of three sorts of enrichment are arranged cylindrically. The steam generators are vertical type heat exchangers with pipes made of high nickel alloy (Inconel). As for the technological safety system provided against the loss of coolant in hypothetical accidents such as the breakage of coolant boundaries, there are emergency core cooling systems which inject cooling water into reactor core, and reactor containment vessels, spray system and ventilating system for the containment vessels which prevent the diffusion of radioactive products. (JA)

28663 THE FIRST REVISION IN THE NUCLEAR POWER PLANT STADE. Goetz, A. (Kernkraftwerk Stade G.m.b.H. (KKS) (F. R. Germany)). Atomwirt., Atomtech.; 19: No. 6, 302-306 (Jun 1974). (In German).

5 figs.; 2 refs.

The putting into operation of the nuclear power plants Stade and Wuergassen in the German Federal Republic started the commercial application of nuclear energy in large plants. The first revision being done in the nuclear power plant Stade after 10,000 hours of operation is described. The expenditure of work for this first revision has been 12,000 man days at a 10 hour working time. Additionally remaining and guarantee works, cleaning works and protection survey were carried out. The results of this revision showed an excellent condition of the components. Therefore, only partial revisions will be necessary in the future during the annual fuel element change, thus considerably reducing the expenditure of work. (GE)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 27542, 28746, 28751, 28797, 28817, 28821, and 28823.

28664 (AED-CONF-74-044-011) NOISE THERMOMETRY—AN ABSOLUTE THERMOMETER FOR IN-CORE USE IN NUCLEAR REACTORS. Brixy, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). 1974. 14p. (In German). INIS.

From exhibition and experts' meeting "nuclear technology"; Frankfurt am Main, F. R. Germany (18 Mar 1974).

8 figs.; 1 ref.

Noise thermometry can be used in the range between 1°K and 2,500°K, possibly even up to 3,000°K. The measuring accuracy is about 0.1%. With a noise thermometer, other temperature measuring instruments can be easily calibrated, and it is almost completely independent of environmental effects. As it requires expensive electronic equipment, it will preferably be used in cases where other methods yield inaccurate results or fail, for instance in in-core measurements in high-temperature reactors. (GE)

28665 (CEA-CONF-2563) HIGH TEMPERATURE REACTORS AND THEIR EVENTUAL DEVELOPMENT TOWARD THE DIRECT CYCLE AND TOWARD GAS BREEDERS. Vendryes, G.; Rastoin, J.; Combeau, P.; Faure, J. (Societe des Electriciens, des Electroniciens et des Radioelectriciens, 92-Malakoff (France)). 1973. 14p. (In French). (CONF-730983-5). Dep. NTIS (US Sales Only) $4.00.

From congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France (11 Sep 1973).

The main characteristics of the HTGR reactor are described together with the alternative development specifications being pursued by various groups. Significant features of the design (such as environmental considerations) are mentioned, and the application of the design to direct cycle cooling systems, process heat production, and gas cooled breeder reactors are discussed. The outlook for a concerted international developmental effort is also discussed. (DG)

28666 (CONF-730907-P1, pp 370-375) TRAPPING AND DESORPTION OF IODINE IN GRAPHITE GAS REACTORS. Barbier, J.; Benezech, G.; Cadet, B.; Miribel, J.; Sigli, P. Feb 1974. (In French).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

In the six gas-cooled reactors operated by Electricité de France, the usual analyses indicate iodine absorption by internal structures. In order to corroborate this hypothesis, a test was attempted in Chinon 1 reactor. It consisted in the study of activity evolution and physico-chemical form of iodine after having introduced molecular ^{131}I in the coolant. The results show a very quick transformation of molecular iodine in penetrating forms. The trapping speed by internal structures is high; the desorption phenomenon is slow. (auth)

28667 (GA-A-13072) HTGR FUEL DESIGN AND PERFORMANCE. Stansfield, O. M. (General Atomic Co., San Diego, Calif. (USA)). 12 Jul 1974. Contract AT(04-3)-167. 43p. (CONF-740804-2). Dep. NTIS $5.25.

From American Institute of Chemical Engineers; Salt Lake City, Utah, USA (18 Aug 1974).

The High-Temperature Gas-Cooled Reactor (HTGR) core contains a large number (approximately 10^{11}) of UC_2 and ThO_2 kernels that are individually coated with TRISO and BISO coatings, respectively, and bonded in a carbonaceous matrix to form a fuel rod that is highly retentive of fission products. Out-of-pile tests with both irradiated and unirradiated fuel have been used to characterize the thermal failure mechanism. The in-pile testing of HTGR fuel is used to characterize the irradiation properties of materials and define acceptable limits for coating and fuel rod property variables. Irradiation capsules serve as the most effective vehicles for verification of thermal and mechanical performance prediction. 14 references. (auth)

28668 IMPROVEMENTS IN OR RELATING TO FUEL FOR NUCLEAR REACTORS. Prince, K.; Shennan, J. V. (to United Kingdom Atomic Energy Authority). US Patent 1,347,487. 20 Feb 1974. Filed date 8 Jul 1970. 2p.

Methods of fabrication and geometrical variations of graphite-sheathed coated particle fuel compacts are described. (DG)

28669 PLUTONIUM COATED PARTICLES DEVELOPMENT. Bairiot, H. (Belgonucleaire SA, Brussels); Aerts, L.; Trauwaert, E.; Vangeel, J. Nucl. Technol.; 23: No. 3, 240-255(Sep 1974).

The economics of plutonium fueling of a thorium-cycle high temperature gas-cooled reactor (HTGR) was investigated. The study showed that once-through cycles are more profitable than cycles with ^{233}U recycling in the fissile particles and cycles with ^{233}U recycling in the fertile particles, if limitation of age factors are applied and if core power densities are fixed. There is an economic advantage in using plutonium in once-through cycles once its price drops below 9 $/g Pu_f. The highest plutonium loading per particle provides the most attractive fuel cycle cost during the initial period when the fabrication costs are high. In the first irradiation test, which was carried out in the R 2 reactor (Studsvik-Sweden), burnups of 200,000 MWs/MTM and 370,000 MWd/MTM at temperatures of 1850 and 1200°C were reached. In a second test, the center rods of two DRAGON reactor fuel elements were fabricated with plutonium fuel. After irradiation equivalent to 224 days at full power, there was no damage to the particles. Finally, three batches of particles with diluted and undiluted kernels were irradiated during 45 equivalent full power days by KFA/Jülich. The postirradiation results were consistent with no fission gas release and no breakage events. A migration of plutonium occurred to a small extent up to the SiC layer in some of the particles. (auth)

28670 FITTINGS AND REGENERATORS FOR NUCLEAR POWER STATIONS WITH HIGH-TEMPERATURE REACTOR AND GAS TURBINES. Bachl, H. (Technische Univ. Muenchen (F. R. Germany). Inst. fuer Energiewirtschaft und Kraftwerkstechnik). Brennst.-Waerme-Kraft; 26: No. 6, 241-244(Jun 1974). (In German).

7 figs.; 12 refs.

The requirements on fittings for single-cycle nuclear power stations with helium as the cooling medium are discussed. The concept of a quick-closing valve for high temperatures and flow rates is presented, including details of design. The advantages and operation of regenerators with change-over fittings, the development of which has allowed a simpler overall layout of a single-cycle nuclear power station are discussed. The advantages of the reactor being arranged in the low-pressure range of the cycle are discussed. (auth)

28671 STUDIES ON THE HEAT-RESISTING METALS FOR SUPER HIGH TEMPERATURE GAS REACTORS. Sakakibara, M. (Nippon Steel Corp., Fukuoka). Kinzoku Zairyo; 13: No. 12, 85-95(Dec 1973). (In Japanese).

It has been concluded that the iron manufacturing process with super high-temperature gas-cooled reactors is more economical than blast furnace process. To this end, the selection and develop-

ment of the materials usable safely at 1,000°C for a long time was carried out. Corrosion in He or in Co and H_2 at 1,000°C for a long time, creep rupture strength, thermal fatigue from room temperature to 1,000°C, weldability, produceability, and reliability are examined. It is concluded that Incoloy 800 and Inconel 600 are to weak to ensure a rupture strength of 1 kg/mm² at 1,000°C for 10^5 hours. Hastelloy X, C, Inconel 625, and Incoloy 807 are stronger than the above two alloys, but are unsatisfactory. Astroloy, Nimonic 115, and Réne 41 are expected to be the strongest among these alloys, but they are not enough to maintain their rupture strength in He environment or stress change. Therefore, dispersion-strengthened alloys such as TD–Ni and Inconel 853 come to the fore. Surface treatment and composite pipes have to be considered against the corrosion. The thermal fatigue strength has to be examined more precisely. Solid-solution-type alloys such as Incoloy 800, Inconel 600, and Hastelloy are superior in weldability. Alloys with combined γ'-strengthening and solid-solution strengthening effects should be developed. It is desirable to develop new manufacturing processes such as gatorizing and minigrain process. (JA)

28672 OUTLOOK FOR HIGH TEMPERATURE NUCLEAR REACTORS IN THE MIDDLE OF 1973. Pericart, J. (Electricite de France, Paris). Sci. Tech. (Paris); No. 5, 16-24 (15 Jun 1973). (In French).

The current situation concerning HTR reactors is analyzed. These reactors provide a logical succession to earlier Franco-British natural uranium graphite moderated and gas cooled reactors. The use of coated particles, however, is an important mutation to these earlier types of reactor. The principal differences possible in the conception of HTR's are reviewed: fixed prismatic core or pebble-bed core; direct or indirect cooling circuit. The different types of fuel cycles possible are discussed: uranium and thorium; slightly or highly enriched fuels. Much freedom of choice is available in this field. Special problems associated with the use of helium as a coolant are then dealt with. Although helium is chemically inert, problems of leak tightness and purity arise. The reactor block is then described and safety problems considered. The current state of development is discussed together with the projects being undertaken. A synthesis of the available information is presented. The favorable aspects of these reactors seem to outweigh the unfavorable ones and their chance of making a real industrial breakthrough appears very good. (FR)

28673 MULTI-PURPOSE UTILIZATION OF NUCLEAR ENERGY. Nuclear Energy Utilization for Iron-Making. Shimokawa, K. (Nippon Steel Corp., Tokyo). Karyoku Genshiryoku Hatsuden; 24: No. 5, 581-588(May 1973). (In Japanese).

In iron-making by coke burning in Japan, the stable supply of coal depending on imports and environmental pollution are grave problems. Herein emerges the utilization of nuclear reactors, for which the development of HTGRs presents a boon. After reviewing the background for nuclear iron-making and direct reduction process, the studies made in the Iron and Steel Institute of Japan are described. In direct reduction, He reducing gas used in shaft furnaces or by fluidized bed process is suitable for nuclear iron-making. For the production of reducing gas, the heating of liquefied gas and oil by He gas is an alternative. The heat exchangers between He and steam are shown to have possibilities. Finally, the economy of nuclear iron-making is discussed. (JA)

28674 HTGR PLANT. Hirata, A. (Electric Power Development Co. Ltd., Tokyo); Tachibana, A. Karyoku Genshiryoku Hatsuden; 24: No. 5, 484-490(May 1973). (In Japanese).

The development history of HTGR's in various countries is briefly reviewed. Short reviews on the Dragon project in Britain, AVR and THTR in West Germany, and Peach Bottom and Fort St. Vrain in the U. S. A. are given. A description on the design and fuel cycle of the 1160 MW(e) HTGR plant developed and being proposed by GGA is presented. The layout of the plant is shown and reaction design parameters and the arrangement of reactor components within a PCRV are explained. Refueling schemes, the arrangement of control rods and their driving mechanism, and the back-up shutdown facility are also explained. Descriptions of coated fuel particles (BISO and TRISO) and the structure of hexagonal fuel blocks are given. The outline of the PCRV, helium circulator, steam generator and auxiliary cooling systems are also explained. Finally, the fuel cycle proposed by GGA (high enriched uranium/thorium cycle) is explained. Flexibility in the fuel cycle such as a low enriched uranium cycle and a thorium cycle with plutonium supply is discussed. (JA)

28675 FISSION PRODUCT RELEASE FROM HIGH-TEMPERATURE REACTOR CORES. Mielken, G. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Projekt Hochtemperaturreaktor mit Heliumturbinen). Kerntechnik; 16: No. 6, 266-272(Jun 1974). (In German, English).

4 figs.; 6 refs.

The design criteria for helium-cooled high temperature reactors are governed to a large extent by the question of release of fission products from the reactor core and of the deposition and distribution of solid fission products in the reactor system. A survey of the current status of knowledge regarding the release of fission products from HTR cores is presented, based on the results of numerous irradiation experiments completed so far and on their mathematical and physical interpretation. The paper is concerned chiefly with the fuel particles and fuel element types under discussion at present in connection with their anticipated fission product retention performance in real reactor cores with a high power rating, and with the differences between various particle and fuel element types. (GE)

28676 A PROPOSAL FOR INCREASING THE SAFETY OF SINGLE-CYCLE POWER STATIONS WITH HIGH-TEMPERATURE REACTORS. Bachl, H. (Technische Univ. Muenchen (F. R. Germany)). Kerntechnik; 16: No. 6, 273-275(Jun 1974). (In German).

3 figs.; 10 refs.

The already high operational safety of a single-cycle nuclear power station can be further increased by liner cooling with a part flow of helium, the thermal stresses of the inserts can be reduced and heat losses recovered. Proposed practical designs are submitted. (GE)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstract 28804.

28677 (CNEA-CNA-2) SOME ASPECTS OF THE PHYSICAL DESIGN OF THE ATUCHA NUCLEAR POWER STATION. Solanilla, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 15p. (In Spanish). INIS.

The distinct factors which alter the reactivity coefficient in a reactor in operation are described with particular reference to the Nuclear Center at Atucha. The variation of the reactivity is described as a function of the burnup and the exchange of fuel elements in the stage prior to the condition of equilibrium or of design of the core of the Atucha reactor. (tr-auth)

Power Reactors, Breeding

Refer also to abstracts 27497, 28665, 28725, and 28757.

28678 (AED-CONF-74-066-004) DESIGN, SPECIFICATION AND CONTROL OF SNR FUEL PINS. Kummerer, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). 1974. 6p. (In German). INIS.

From status report of the Projekt Schneller Brueter; Karlsruhe, F. R. Germany (26 Mar 1974).

Investigations concerning fuel pin models using detailed computing programs; the design and specification of SNR typical fuel pin experiment; fabrication studies for UO_2–PuO_2 mixed oxide; check-up of fuel pin irradiations as well as quality control for fuel, fuel cans, and fuel pins are reported. (auth)

28679 (AEC-CONF-74-066-006) INVESTIGATIONS ON ADVANCED FUEL AND CANNING MATERIALS FOR FAST BREEDER REACTORS. Status Report of the Projekt Schneller Brueter, Karlsruhe, F. R. Germany. Goens, J. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1974. 7p. INIS.

The research and development work on advanced fuel and canning materials forms part of a co-ordinated basic program, carried out by the DeBeNeLux research centers. This long-term program aims at the further optimization of the fuel element concept in view of later commercial application of fast breeder reactors. A short survey of the most important contributions of the research centers to the basic investigations on uranium and uranium–plutonium carbide fuel, as well as to the development of improved canning material, is presented. (auth)

28680 (ANL-RDP-29) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JUNE 1974. (Argonne National Lab., Ill. (USA)). 2 Aug 1974. Contract W-31-109-eng-38. 140p. AT.

Progress is reported in the following areas: (1) EBR-2 analysis and testing, (2) LMFBR design support, (3) instrumentation and control, (4) fuels and materials development, (5) reactor kinetics, (6) reactor safety, (7) GCFR experiments and studies, and (8) irradiation behavior of carbide fuel. (DG)

28681 (CENC-1194(Vol.4)(Suppl.1)) LMFBR DEMONSTRATION PLANT STEAM GENERATING SYSTEM. (Combustion Engineering, Inc., Chattanooga, Tenn. (USA)). Feb 1973. Contract AT(11-1)-3031. 180p. Dep. NTIS $12.00.

The thermal transient model calculation is presented for the steam generating system of an LMFBR demonstration plant. (DCC)

28682 (CONF-730907-P1, pp 388-393) MONITORING TECHNIQUE FOR RADIOIODINE IN SODIUM AEROSOL. Naritomi, M.; Murata, M.; Yoshida, Y. (Japan Atomic Energy Research Inst., Tokai). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Radioiodine monitoring in a liquid-metal fast breeder reactor is different from that in the other types of reactor because radioiodine is always associated with the radioactive sodium aerosol. In this connection, experiments were made on the behavior of the iodine and collection characteristics of an air sampler. In the experiment, the fume of sodium containing sodium iodide was produced by vaporization of the liquid sodium, labeled with ^{24}Na and ^{131}I. It was then introduced through a fume transport tube into an ageing chamber with control of the temperature and relative humidity of air. Characteristics of the airborne iodine in the sodium aerosol in the chamber were examined with Maypacks. About 97% of iodine in the aerosol at room temperature is in particulate form (as sodium iodide), and percentage of gaseous iodine increases with rise of the fume temperature to about 30% at 400°C. More than 99% of the iodine in the aerosol can be collected by a particulate and a charcoal filter paper in the sampler. In order to detect the radioiodine in sodium aerosol, however, the iodine should be collected separately from the sodium aerosol. For monitoring radioiodine in aerosol, a sampling technique with an arc discharge was contrived. It consists in the decomposition of aerosol followed by the iodine sampling. The portion of sodium and of iodine thus separated are collected in the particulate and the charcoal filter paper, respectively. (auth)

28683 (JAERI-M-5449) EFFECTS OF FISSION PRODUCTS ON THE PHYSICS PARAMETERS OF LARGE FAST REACTORS AND UNCERTAINTIES IN THE PHYSICS PARAMETERS DUE TO THE FISSION-PRODUCT NUCLEAR DATA UNCERTAINTIES. Tone, T. (Japan Atomic Energy Research Inst., Tokyo). Nov 1973. 62p. NTIS (US Sales Only).

The effects of fission products accumulating with fuel burnup on the physics parameters of large fast reactors have been investigated. The effects on the effective multiplication factor, the sodium void reactivity, and the transformation of fuel composition at a specific burnup do not depend on the history, but almost entirely on the amount of fission products accumulated by that time. The effect on the internal breeding ratio is insignificant. The effect on the effective delayed neutron fraction is only slight, while that on the prompt-neutron lifetime is appreciably large. The uncertainties in the currently available radiative capture cross section and yield data of fission products and the influences on the effective multiplication factor and the sodium void reactivity are also discussed. The uncertainties in radiative capture cross sections of the individual fission product nuclides are reduced considerably by cancellation resulting from their lumping. The uncertainty in the lumped radiative capture cross sections of ^{235}U-FP is about 10%, while those for other fissile elements are about 3.5%. The uncertainties in ^{239}Pu-FP, for example, produce about a 0.2% reactivity uncertainty in the effective multiplication factor and the sodium void reactivity, respectively, in large fast reactors at high burnup. Various sets of the lumped group radiative capture cross sections calculated for the different fission-product nuclear data are given. (auth)

28684 (ORNL-TM-4058) HIGH-TEMPERATURE STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS. Quarterly Progress Report for Period Ending September 30, 1972. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1973. Contract W-7405-eng-26. 246p. AT.

Progress in the development of high-temperature structural design methods for LMFBR vessels, components, and core structures is reported in the areas of: (1) elastic-plastic and time-dependent behavior studies, (2) structural analysis and testing, (3) material investigations, (4) study of the effect of biaxiality in creep-fatigue at elevated temperatures, (5) study of thermal ratchetting behavior and elastic design requirements, (6) high-temperature creep collapse tests of piping elbows, (7) development of a simplified inelastic design analysis for piping systems, and (8) design criteria for core structural components. Extensive data on Type 304 stainless steel are reported. (DG)

28685 (ORNL-TM-4677) INFORMAL PROGRESS REPORTS ON STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS FOR PERIOD ENDING MAY 31, 1970. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 41p. AT.

Progress in the development of high-temperature structural design methods for LMFBR vessels, components, and core structures is reported in the areas of: (1) program planning and coordination, (2) interim design criteria studies, (3) elastic-plastic behavior studies, (4) time-dependent behavior studies, (5) structural analyses and tests, (6) material investigations, and (7) design methods for core structurals. (DG)

28686 (ORNL-TM-4678) INFORMAL PROGRESS REPORTS ON STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS FOR PERIOD ENDING JUNE 30, 1970. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 24p. AT.

Progress in the development of high-temperature structural design methods for LMFBR vessels, components, and core structures is reported in the areas of: (1) program planning and coordination, (2) elastic-plastic behavior studies, (3) time-dependent behavior studies, (4) structural analyses and tests, (5) material investigations, and (6) design methods for core structurals. (DG)

28687 (ORNL-TM-4679) INFORMAL PROGRESS REPORTS ON STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS FOR PERIOD ENDING JULY 31, 1970. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 30p. AT.

Progress in the development of high-temperature structural design methods for LMFBR vessels, components, and core structures is reported in the areas of: (1) program planning and coordination, (2) elastic-plastic behavior studies, (3) time-dependent behavior studies, (4) structural analyses and tests, (5) material investigations, (6) studies of creep-fatigue interaction and cumulative damage criteria, and (7) design methods for core structurals. (DG)

28688 (ORNL-TM-4680) INFORMAL PROGRESS REPORTS ON STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS FOR PERIOD ENDING AUGUST 31, 1970. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 28p. AT.

Progress in the development of high-temperature structural design methods for LMFBR vessels, components, and core structures is reported in the areas of: (1) program planning and coordination, (2) elastic-plastic behavior studies, (3) time-dependent behavior studies, (4) structural analyses and tests, (5) material investigations, (6) studies of creep-fatigue interaction and cumulative damage criteria, and (7) design methods for core structurals. (DG)

28689 (ORNL-TM-4681) INFORMAL PROGRESS REPORTS ON STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS FOR PERIOD ENDING SEPTEMBER 30, 1970. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 39p. AT.

Progress in the development of high-temperature structural design methods for LMFBR vessels, components, and core structures is reported in the areas of: (1) program planning and coordination, (2) elastic-plastic behavior studies, (3) time-dependent behavior studies, (4) structural analyses and tests, (5) material investigations, (6) the behavior of welded joints in stainless and alloy steels at elevated temperatures, and (7) design methods for core structurals. (DG)

28690 (ORNL-TM-4682) INFORMAL PROGRESS REPORTS ON STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS FOR OCTOBER AND NOVEMBER 1970. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 41p. AT.

Progress in the development of high-temperature structural design methods for LMFBR vessels, components, and core structures is reported in the areas of: (1) program planning and coordination, (2) elastic-plastic behavior studies, (3) time dependent behavior studies, (4) structural analyses and tests, (5) material investigations, (6) behavior of welded joints in stainless and alloy steels at elevated temperatures, (7) creep-fatigue studies, and (8) design methods for core structurals. (DG)

28691 (ORNL-TM-4683) INFORMAL PROGRESS REPORTS ON STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS FOR DECEMBER 1970 AND JANUARY 1971. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 66p. AT.

Progress in the development of high-temperature structural

design methods for LMFBR vessels, components, and core structures is reported in the areas of: (1) program planning and coordination, (2) elastic–plastic behavior studies, (3) time-dependent behavior studies, (4) structural analyses and tests, (5) material investigations, (6) design methods for core structurals, (7) creep-fatigue studies, and (8) the behavior of welded joints in stainless and alloy steels at elevated temperatures. (DG)

28692 (ORNL-TM-4684) INFORMAL PROGRESS REPORTS ON STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS FOR FEBRUARY AND MARCH 1971. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 64p. AT.

Progress in the development of high-temperature structural design methods for LMFBR vessels, components, and core structures is reported in the areas of: (1) program planning and coordination, (2) elastic–plastic behavior studies, (3) time-dependent behavior studies, (4) structural analyses and tests, (5) material investigations, (6) design methods for core structures, and (7) the behavior of welded joints in stainless and alloy steels at elevated temperatures. (DG)

28693 (ORNL-TM-4685) INFORMAL PROGRESS REPORTS ON STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS FOR APRIL AND MAY 1971. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 50p. AT.

Progress in the development of high-temperature structural design methods for LMFBR vessels, components, and core structures is reported in the areas of: (1) program planning and coordination, (2) elastic–plastic behavior studies, (3) time-dependent behavior studies, (4) structural analyses and tests, (5) material investigations, (6) design methods for core structures, (7) creep-fatigue studies, and (8) the behavior of welded joints in stainless and alloy steels at elevated temperatures. (DG)

28694 (ORNL-TM-4686) INFORMAL PROGRESS REPORTS ON STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS FOR JUNE AND JULY 1971. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 72p. AT.

Progress in the development of high-temperature structural design methods for LMFBR vessels, components, and core structures is reported in the areas of: (1) elastic–plastic behavior studies, (2) time-dependent behavior studies, (3) structural analyses and tests, (4) material investigations, (5) design methods for core structures, (6) creep-fatigue studies, and (7) analytical ratchetting studies. (DG)

28695 (RT/FI-(74)8) NADYP, A DYNAMIC CODE FOR FAST REACTORS: DESCRIPTION OF THE PHYSICO-MATHEMATICAL MODEL. Buffoni, G.; Galati, A.; Mosiello, R.; Musco, A.; Norelli, F.; Stanescu, C. D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb 1974. 39p. (In Italian). Dep. NTIS (US Sales Only) $5.00.

The two dimensional dynamics code NADYP calculates the power distribution in a fast reactor during transients due to normal operation and/or accidents. The power excursion is followed up to the sodium boiling. Fuel melting and movement, sodium-fuel interaction, stress and strains problems were not included up-to-now in the model. The physical model and the numerical and mathematical methods are described. (11 references) (auth)

28696 (WARD-CR-3045-6) CORE RESTRAINT DEVELOPMENT. Quarterly Progress Report for Period Ending May 31, 1974. Thompson, D. C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Aug 1974. Contract AT(11-1)-3045. 22p. AT.

Preparation for 121-assembly core restraint development tests is continuing. Procedures for calibration of assembly and test equipment were prepared. Approximately 85 percent of the hardware for simulated fuel assemblies was delivered; preparation for assembly and calibration of these components was completed. Final design of fixtures to be used for plug-in and insertion/withdrawal tests is continuing. Duct bow measurement assemblies (DBMA) were prepared for final alignment. Instrumentation for DBMA testing was assembled and calibrated. Final alignment of the facility for characterization tests was initiated. Procurement of material for full core tests was initiated. Construction of the enclosure over the test facility was completed. In July 1974, 121 assembly tests are scheduled to start. (auth)

28697 (WARD-NA-3045-12) SODIUM TECHNOLOGY PROGRAM: FRICTION, WEAR, AND SELF WELDING. Quarterly Progress Report for Period Ending April 30, 1974. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Advanced Reactors Div.). Jul 1974. Contract AT(11-1)-3045. 62p. AT.

Progress is reported in friction, wear, and self-welding testing of LMFBR material combinations in interface configurations simulating reactor components under prototypic operating conditions. (DG)

28698 CLINCH RIVER BREEDER REACTOR PROJECT. Behnke, W. B. Mater. Eval.; 32: No. 5, 22A-23A (May 1974).

Brief comments on the planning and construction timetable of the CRBR project are presented. (DG)

28699 EXPERIMENTAL DETERMINATION OF SODIUM SUPERHEAT EMPLOYING LMFBR SIMULATION PARAMETERS. France, D. M.; Carlson, R. D.; Rohde, R. R.; Charmoli, G. T. (Argonne National Lab., IL). J. Heat Transfer; 96: No. 3, 359-364 (Aug 1974).

Sodium superheat experiments were performed in a forced convection facility employing system parameters in the range of interest for application to loop and pot-type liquid metal cooled fast breeder reactors. The test section was representative of a single reactor fuel element with sodium flowing vertically upward in an annulus heated indirectly from the inside wall only. Steady-state operating parameters prior to a flow coast down approach to boiling included: velocity, 17 fps; heat flux, 7×10^5 Btu/hr-ft^2; test section inlet, 600°F; test section outlet to plenum, 900°F; plenum, 15 psia at 900°F and 700°F. Other important system variables controlled included sodium inert gas content and system pressure-temperature history. The axial location of boiling initiation in the test section was measured. Five test series encompassing 33 test runs were performed. Applicable superheat results were compared to predictions of the pressure-temperature history model including inert gas effects. (auth)

28700 PHYSICAL AND TECHNICAL PROBLEMS OF ATOMIC POWER STATIONS WITH FAST REACTORS. Szabo, F. Musz. Tud.; 48: No. 1-2, 103-118 (1974). (In Hungarian).

After reviewing the basic advantages and risks of the fast breeder reactors the differences between the physics of fast reactors and of thermal reactors are discussed. Problems of nuclear safety are described. The experiences with the first generation of fast reactors and the role of the demonstration atomic power plants now being built are reviewed. (auth)

28701 GAS COOLED BREEDER REACTOR-ECONOMIC POWER WITH BREEDING. Nucl. Eng. Int.; 19: No. 218, 566-571 (Jul 1974).

The current design concept resulting from the work of the Gas Breeder Reactor Association is the GBR-4, a helium-cooled pin fuelled 1200 MW(e) power reactor. Parameters are given for the reference design and also for a slight modification using a smaller fuel pellet for lower U consumption. Descriptions are given of the reactor core, fuel assembly, energy supply and emergency cooling systems. The high power density needed for good breeding performance leads to a special feature, the pressure equalization system, which prevents damage to the fuel cladding by the high coolant pressure. Safety features are compared with those of the LMFBR. It is expected that the system would become increasingly competitive, economically. It has good development potential and the use of alternative cladding material and of coated fuel particles for higher coolant temperature operation are discussed. It is considered desirable at this stage to construct a 600 MW(e) demonstration plant. (UK)

28702 PHENIX 4 FAST BREEDER POWER PLANT. Aubert, M. (CEA, Paris); Boulinier, C. Nucl. Eng. Int.; 19: No. 218, 563-566 (Jul 1974).

Following the start-up and operation of the Phenix demonstration plant it is possible to consider 250 to 500 MW(e) plants based on this concept. A 450 MW(e) plant is described and main parameters are given. Pumps and intermediate heat exchangers are directly extrapolated from Phenix, a four secondary loops design with eight intermediate heat exchangers being chosen to give lower extrapolation factors. Fuel bundle and steam generator module are not changed. The temperature cycle adopted takes into account results from the Phenix start-up, and also from developments in fuel technology. Refuelling shut-downs are reduced to two per year. Fuel is discharged directly to an external storage. Main safety features concern the containment, core cooling, supervision, and fuel handling. (UK)

28703 PROTOTYPE FAST REACTOR AT DOUNREAY. MacRae, W. (Nuclear Research Power Group Ltd., Knutford, Eng.). Electron. Power; 20: No. 14, 581-584 (8 Aug 1974).

Fast-breeder reactors like the Dounreay prototype (p.f.r.) are going to play an important part in providing future needs. The Dounreay prototype aims to rrove its operational reliability and so be the pioneer for larger more powerful nuclear power stations. The construction of the p.f.r. is virtually complete, and it

is currently being commissioned. Apart from reliability testing the reactor will be used to prove thoroughly the fuel and irradiate alternative fuel concepts, to minimize fuel-cycle costs through lower fuel fabrication costs, higher fuel burnup in the core and enhanced breeding performance. A general description of the site layout is given. The primary circuit, the secondary circuits and steam generator, and fuel and fuel handling, are discussed. The construction program is outlined. (UK)

28704 TRIANGULATION OF LOCAL COOLANT BOILING BY CROSS-CORRELATING ACOUSTIC NOISE SIGNALS. Nishihara, H. (Kyoto Univ.). Nucl. Technol.; 23: No. 3, 222-232(Sep 1974).

Unambiguous and early detection of anomalous coolant boiling in nonboiling liquid-cooled reactors, especially in liquid-metal fast breeder reactors, is of great significance from the viewpoint of reactor safety. Acoustic detection of boiling is promising but is often hampered by existing background noise. Cross-correlating noise signals may alleviate this problem and also locate the anomaly. The characteristics of the cross-correlation functions of acoustic boiling noise were investigated experimentally. A pair of hydrophones detected local boiling of water in a container tank. The nucleate local boiling was generated in the tank by electrically heating a small segment of simulated fuel rod. Measurements were taken in pure water as well as in a heterogeneous medium with simulated rod bundles. In general, acoustic boiling noise signals with duration times of <50 msec successfully located the boiling site from the observed peak shifts of the cross-correlation functions when the signals were used in the off-resonance frequency region. (auth)

28705 FLOW PATTERNS IN SODIUM COLD TRAP CRYSTALLIZER. Lester, D. H. (Battelle Pacific Northwest Labs., Richland, WA); Bloom, G. R. Nucl. Technol.; 23: No. 3, 284-289(Sep 1974).

Use of inlet mixing nozzles to distribute flow in sodium cold trap crystallizers was investigated. Water modeling tests were conducted in a 100-gal plastic model at water flows of 5.7 to 30 gal/min. During these tests a salt water tracer pulse was introduced into the inlet stream. This tracer was detected by conductivity probes placed in the tank at various angular locations at the top, middle, and bottom. Flow and water temperature in the tank were adjusted to satisfy hydraulic similarity, defined by matching a mixing and flow Reynolds number in the model and sodium component. The results of these tests indicate that modification of the inlet pipe at a 90-deg bend, directed tangentially on the annulus centerline, will produce significant improvements of flow distribution. (auth)

28706 BREEDER REACTORS. Status Report "Fast Breeder" 1974. Wagner, W. (Verein Deutscher Ingenieure, Dusseldorf (F. R. Germany)). Energie; 26: No. 6, 208-212(Jun 1974). (In German).

7 figs.; 1 ref.

The necessity of using breeder reactors is based on an estimate of the world's demand for and the supply of energy until 2020. Following a few basic comments on this type of reactor, a report is given on the state of development work of the SNR 300, the experience with the KNK, the development of fuel elements and materials, and on questions of physics and safety. (GE)

28707 MACHINE COMPONENTS FOR USE UNDER SODIUM. Removille, J. (Commission of the European Communities, Luxembourg); Sims, J. (Luxatom, Luxembourg). Kerntechnik; 16: No. 5, 201-207(May 1974). (In German, English).

10 figs.; 2 refs.

In connection with a research program in the field of remote manipulation techniques and their application for breeder reactors, various machine components suitable for use in liquid sodium have been developed and tested. These components could be used, for example, in a machine for dismantling spent breeder reactor fuel assemblies under sodium after a very short decay time. Problems of mechanical motion in liquid metals are examined. The results of tests carried out on various machine components such as bellows-sealed cylinders, magnetic couplings, limit switches, remotely actuated tongs, and a ball screw and spline spindle drive are described. Further experiments are planned. (auth)

Research, Test, and Experimental Reactors

Refer also to abstracts 27100, 27574, 27575, 28680, 28697, 28740, and 28768.

28708 (AEEW-M-1272) ZEBRA MULTI-CHAMBER SCANNING SYSTEM. Batt, R. G.; Goodings, A.; Marshall, J.; Sanders, J. E.; Sweet, D. W. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Jul 1974. 25p. Dep. NTIS (US Sales Only) $4.25. UK £0.50.

The Multi-Chamber Scanning System developed for the zero-power fast reactor Zebra comprises an integral array of 150 parallel-plate fission chambers loaded into fuel elements in a similar manner to standard core components. The chamber outputs are counted sequentially under computer control to provide a rapid three-dimensional power mapping facility. The basic concept, design and calibration of the fission chambers, design of the electronics and computer interface, and overall system performance as exemplified by measurements on a mock-up of the core of the Prototype Fast Reactor are described. (auth)

28709 (AREAEE-174) FAST NEUTRON FLUX DISTRIBUTION IN THE EGYPTIAN-REACTOR CORE CAVITY, THEORETICAL AND EXPERIMENTAL. El-Mofty, O. H.; Salama, F. E.; Goher, Y. (Atomic Energy Establishment, Inshas (Egypt)). 1973. 18p. INIS.

The theoretical and experimental treatments of the fast and thermal neutron flux distributions in a rectangular open water cavity were made in the ARE-RR-1 reactor core. A sulphur threshold detector was used for detection. Measurements were done along chosen directions approximating slab geometry conditions. The two-group diffusion equation in one dimension was applied for an ideal multizone core using a new computation method. Four zones were recognized, sub-core I, water cavity, sub-core II, and water reflector on the two sides. The data are presented in tables for absolute and relative units as well as comparative curves. The theoretical and experimental treatment of the problem came to a good agreement, showing depression of fast flux of 26%. The minimum was shown not to coincide with the center of the cavity but shifted away from the core center. Slight deviation between experiments and theory was observed and it is explained by the depletion of core in the central zone as well as by the effect of control rods. (INIS)

28710 (BNWL-1200-2) SODIUM TECHNOLOGY QUARTERLY REPORT, OCTOBER, NOVEMBER, DECEMBER 1969. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1970. Contract AT(45-1)-1830. 158p. Dep. NTIS $11.00.

Progress in the development, proof testing, and documentation of methods to characterize and control the coolant quality of FFTF is reported. (JWR)

28711 (CEA-N-1707) NUCLEAR REACTOR PERIOD AND REACTIVITY MEASUREMENTS WITH A MINI-COMPUTER. Tapu, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). Oct 1973. 49p. (In French). (SES-PUB-SAI-73-236). Dep. NTIS (US Sales Only) $5.50.

Nuclear reactor measurement equipment, including a minicomputer, has been used to determine neutron power, period, and reactivity. The programs are described together with the results obtained with the Ulysse reactor. (FR)

28712 (CEA-N-1731) CALCULATION OF THE GRAPHITE/NICKEL SPECTRAL INDEX FOR THE DIDO REACTOR USING THE APOLLO CODE. Destot, M.; Labrousse, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services des Piles). Apr 1974. 15p. (In French). Dep. NTIS (US Sales Only) $4.00.

The ϕ_C/ϕ_{Ni} index is almost constant for all the practical loadings envisaged and for the theoretical case of a total loading with graphite or D_2O. (FR)

28713 (CONF-730907-P2, pp 857-863) RETENTION OF IODINE ON DUCT SURFACES. Grummitt, W. E. (Chalk River Nuclear Labs., Ont.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The behavior of fission-product iodine in a reactor exhaust duct and filtering system is of continuing interest. At CRNL parts of the research reactors are cooled with air which is released from a stack located 770 m beyond the absolute filters. Gases are transferred to the stack through a large duct. Occasionally, small amounts of iodine are released to the system from an experimental reactor loop. These nuclides have been used in the present study to measure the hold-up of iodine in the system. 12 references. (auth)

28714 (EUR-4654) CALORIMETRIC MEASUREMENTS OF NUCLEAR HEATING IN THE HFR CORE (CADO 11-16). Presentation of Results, Part I. Kroeckel, H. (Commission of the European Communities, Brussels (Belgium)). 1972. 46p. INIS.

The results of two series of calorimetric measurements are presented, one with a clean core and the other with a representative one. The measurements were carried out in connection with the determination of nuclear heating profiles throughout a reactor cycle. (INIS)

28715 (EUR-4656) DISTRIBUTION OF FISSION PRODUCTS IN IRRADIATED HFR FUEL ELEMENTS. Kreyger, P. J.; Harry, R. J. S. (Commission of the European Communities, Brussels (Belgium)). 1971. 50p. INIS.

Fission product γ-activity distributions have been measured in MTR-type fuel elements of the High Flux Reactor by means of a narrow slit collimator and a Ge–Li detector associated with a 4096 channel analyzer. The measured activity profiles are compared with the thermal neutron fluence distribution and calculated distributions of the power in the fuel elements in order to obtain experimental confirmation of the calculations. The influence of a non-homogeneous uranium distribution on the γ-absorption in the elements and thus on the emitted intensity is discussed. Full energy peak efficiency dependency on the total count rate has been investigated and a method to eliminate the effect is presented. (INIS)

28716 (EUR-5044) COOLANT VOID EXPERIMENTS IN ECO IN 19 ROD U AND U–Pu FUEL CLUSTERS. Hage, W.; Hettinger, H.; Hohmann, H.; Tinagli, F.; Toselli, F.; Schneider, H. (Commission of the European Communities, Brussels (Belgium)). Feb 1974. 26p. INIS.

Critical height variations of the D_2O moderated critical facility ECO as a function of coolant void were measured. The void was generated in a test section of the central fuel element. The aim of the experiments was to study the void effect in a 19-rod fuel cluster with different isotopic contents of fissile and fertile U and Pu isotopes in the exchangeable fuel rods. The experiments were carried out with 3 coolants (D_2O, H_2O and D_2O-H_2O mixture) at 3 lattice pitches. (INIS)

28717 (EUR-5081) TEMPERATURE COEFFICIENT MEASUREMENTS IN ECO WITH Pu-CONTAINING ONE AND THREE ROD FUEL ELEMENTS. Hage, W.; Hettinger, H.; Hohmann, H.; Toselli, F.; Schneider, J. (Commission of the European Communities, Brussels (Belgium)). Feb 1974. 60p. INIS.

Channel temperature coefficient measurements were performed in the D_2O moderated natural uranium critical facility ECO. The purpose of the experiments was to determine the critical height variations as a function of the coolant channel temperature by the progressive substitution technique with natural uranium and uranium plutonium fuel elements. The D_2O or H_2O coolant of 1, 5 and 9 central elements was heated step by step from 20 deg C to 200 deg C. The reactivity effects were measured by two different methods at square lattice pitches between 17.5 cm and 28.05 cm. (INIS)

28718 (IKE-6-76) REACTIVITY INFLUENCE OF MOVABLE REFLECTOR SEGMENTS IN THE CRITICAL EXPERIMENT ITR. Bernnat, W. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Dec 1973. 28p. (In German). INIS.

The critical assembly ITR at Juelich is a compact facility with a rather complicated geometry. The theoretical determination of reactivity and other kinetics parameters is possible only with 3D transport codes, for example Monte Carlo calculations. Such a code suitable to calculate perturbations due to changes in geometry is described here. It is used to calculate two shutdown experiments, the removal of a 2 cm thick reflector from CORE IIa/2 and the positioning of a movable segment in CORE VI. The results are compared with inverse kinetics measurements. (INIS)

28719 (INIS-mf-1311) PROCESS SYSTEMS FOR THE 100-MW THERMAL RESEARCH REACTOR. Radhakrishna, R.; Nayak, A. P.; Raina, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 8p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Heavy water will be used as coolant, moderator and reflector for the 100 MW thermal research reactor. Cold heavy water will be pumped into the reactor at a rate of 68,000 litres/mt to cool the fuel assemblies and to effect an upward flow of moderator and reflector. Hot heavy water coming out from the top of reactor will be cooled by process water (demineralized light water) in a set of heat exchangers. Demineralized water will be circulated in a closed loop which, in turn, will be cooled by chlorinated sea water in a set of heat exchangers. Filters, ion exchangers and degassing tank's will be provided in heavy water and process water systems to control their pH, conductivity, radio-activity, etc. Helium will be used as cover gas for the heavy water system. Palladium catalysts and carbon sorbers will be provided to control the purity of helium. Flywheels and dc pony motors mounted on the shafts of heavy water pumps will provide heavy water circulation during the interruption of ac power supply. An overhead storage tank will provide emergency demineralized water flow to cool heavy water during the period of power interruption. The reactor vault and thermal shield water will be cooled in a separate set of heat exchangers by process water. Adequate instrumentation will be provided to ensure safe and smooth operation of the process systems. (auth)

28720 (JAERI-M-5511) REMOVAL OF FISSION GAS RELEASE LOOP FROM JRR-3. Shiba, K.; Handa, M.; Yamagishi, S.; Fukuda, T.; Takahashi, Y. (Japan Atomic Energy Research Inst., Tokyo). Jan 1974. 40p. (In Japanese). NTIS (US Sales Only).

The Fission Gas Release Loop was removed from the JRR-3 (Japan Research Reactor-3) in August 1973. The works involved in this removal are described: safety considerations, safety examination and post-removal reactor check, containers for activated plugs, the detailed procedure for placement of the plugs in containers and the storage, cautions in disassemblage of the out-of-pile portion, and radiation exposure analysis. In the Appendix are given the equations and calculations for induced activities of the plugs, radiation exposure in handling, and shielding of the containers. (auth)

28721 (ORNL-TM-3234) FEASIBILITY STUDY. Irradiation of Heavy Section Steel Specimens in the South Test Facility of the Oak Ridge Research Reactor. Segaser, C. L. (Oak Ridge National Lab., Tenn. (USA)). May 1971. Contract W-7405-eng-26. 54p. Dep. NTIS $5.75.

Experimental procedures and testing techniques are described for the testing of a thick, irradiated steel specimen. The South Engineering Test Facility of the Oak Ridge Research Reactor is proposed for the irradiation since it is large enough to accommodate a reasonable size specimen and is available. The specimen will consist of a slab similar in size and shape to a 4T compact K_{Ic} specimen, and it will be fabricated from ASTM A 533, grade B, class 1 pressure vessel steel plate. The specimen will remain in the facility for a sufficient length of time to attain a fast neutron ($E > 1$ MeV) fluence of 3×10^{19} neutrons/cm^2 at its midplane. The position of the specimen will be adjusted relative to the reactor core such that the temperature gradient resulting from gamma heating will be held from 550°F in the specimen interior to approximately 500°F at its surface. (auth)

28722 HFBR. A Protracted Tale. Mitchell, W. (Univ. of Reading, Eng.). New Sci.; 63: No. 907, 192-193(25 Jul 1974).

In July 1974 at the Institut Laue-Langevin in Grenoble, British, French and German ministers finally signed the instruments of the international agreement giving Britain a share in the Franco-German High Flux Beam Reactor (HFBR). Fourteen years have elapsed since the idea of such a useful facility was first mooted in Britain. Some of the milestones in this painful progress are outlined and the questions of policy which are raised by this slow process are outlined. It is hoped that these important policy issues have not obscured the excitement of the fields which the HFBR at Grenoble is opening up in the study of the science of condensed matter. Topics which are being studied currently at the facility are listed. (UK)

28723 TRIGA CORE MANAGEMENT MODEL. Naughton, W. F. (Commonwealth Edison Co., Chicago); Cenko, M. J.; Levine, S. H.; Witzig, W. F. Nucl. Technol.; 23: No. 3, 256-272(Sep 1974).

A core management program (TRICOM) has been effected for TRIGA reactors which utilizes three basic types of information: (a) k_{eff} as a function of burnup, (b) relative changes in power fractions of fuel elements as a function of core burnup, and (c) reactivity worth curves for fissile isotopes and neutron absorbers. Experimental measurements have been made with 8.5 wt % uranium and a mixture of 8.5 and 12 wt % uranium-fueled cores, and the results have been compared with those calculated by TRICOM. The analytical and experimental results compare favorably in all cases, particularly when some of the experimentally measured parameters are substituted for those derived theoretically. A significant result of this study program has been the development of an improved refueling scheme for the Pennsylvania State University's Breazeale Nuclear Reactor which replaces depleted 8.5 wt % fuel with 12 wt % uranium fuel. (auth)

28724 FUEL HEATING EQUIPMENT WITH DEUTERIUM CRITICAL ASSEMBLY. Kirimura, Y. (Fuji Electric Co., Ltd., Tokyo). Fuji Jiho; 46: No. 9, 797-802(Sep 1973). (In Japanese).

The DCA (Deuterium Critical Assembly) is used for the development of an ATR which is a D_2O moderated, boiling light-water cooled reactor. The DCA consists of a core tank pierced with calandria tubes containing pressure tubes with nuclear fuel. Fuel heating equipment is used to raise the fuel temperature for experiments on high temperature nuclear characteristics. Externally heated helium gas is circulated through a specially de-

signed pressure and calandria tube assembly. The system comprises the following components: a compressor to compress the helium gas, a tank to remove pressure pulsation, an intermediate heat exchanger between the compressed gas and the gas from the DCA, a heater to raise the temperature of He gas, the critical assembly through which heated He-gas is circulated, an intermediate heat-exchanger, and a main cooler. The fuel temperature in the DCA can be raised to a maximum of 600°C from about 80°C in this way. (JA)

28725 MOCK-UP EXPERIMENT OF JOYO WITH THE AID OF FCA. Hirota, J. (Japan Atomic Energy Research Inst., Tokai); Iijima, T.; Mizoo, N.; Kobayashi, S.; Shirai, N. Doryokuro Giho; No. 8, 62-72(Aug 1973). (In Japanese).

For mock-up experiments for the experimental fast breeder reactor Joyo, the fast critical assemblies (FCA) V-1, V-2, and V-3 were constructed. The V-1 system is the physical mock-up of Joyo. With the V-1 system having a plutonium fuel core with natural uranium blanket, critical mass, heterogeneous effects, fission ratio, fission rate distribution, central reactivity worth; neutron spectrum, sodium void effect, and the Doppler effect were studied. The V-2 system is the second physical mock-up which aimed at experiments on the items which had been unsolved in the V-1 mock-up experiment, and aimed also at the acquisition of basic data for the V-3 system. The V-3 system is the technological mock-up which has six sodium flow channels and natural uranium blanket. With this V-3 system, the worth of a mock-up B_4C control rod was measured by the neutron source multiplication method or by the pulsed neutron method, and the blanket effect and the fission rate distribution were also measured. These mock-up experiments contributed to the design of Joyo in the areas of plutonium enrichment, the specifications of cluster type B_4C control rods, and the estimation accuracy of power distribution. (JA)

28726 A NEW SOLID-STATE SAFETY AMPLIFIER FOR REACTOR CONTROL. Nobar, Y. M.; Moghimi, D. (Teheran Univ. (Iran). Nuclear Centre); Berzezinski, Z. (International Atomic Energy Agency, Vienna (Austria)). Kerntechnik; 16: No. 5, 198-200(May 1974).

3 figs.; 4 refs.

A new transistorized safety amplifier has been designed and constructed for the T.U.N.C. research reactor. The input signals come from two ionization chambers. Each ionization chamber actuates three memory circuits which they operate under a majority voting procedure. Furthermore, each ionization chamber simultaneously actuates the memory circuit of the other by cross coupling. Consequently, reactor scrams will mostly result from faults of nuclear origin, and not of electronic failures. Ease of serving, exchangeability of components, subassemblies and the suitable size are the other advantages of the new system. (auth)

28727 PRODUCTION OF A CLEAN NEUTRON GAS FOR DECAY AND SCATTERING EXPERIMENTS. Dobrozemsky, R. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Forschungszentrum). Nucl. Instrum. Methods; 118: No. 1, 1-37(1 Jun 1974).

It is shown that the neutron densities required for a number of basic experiments with free neutrons can, at present, only be achieved with the thermal-neutron gas produced by a fission reactor. Three basic technological problems in the production of a dense and clean neutron gas were investigated experimentally: measurement of the neutron field in the neutron-gas cavity (flux and current densities, anisotropy), attainment of a low residual gas density in the neutron-gas cavity in the presence of strong radiation fields, and shielding of the measuring device from the primary reactor radiation. In the experiments a dense neutron gas in ultrahigh vacuum was used to determine the electron–neutrino angular-correlation coefficient a by a precision measurement of the recoil-proton energy spectrum in free-neutron decay (0 to 751 eV). A neutron density of 1.42×10^7 neutrons/cm^3 was achieved in a cavity with residual gas density of $< 1 \times 10^9$ molecules/cm^3; this arrangement yielded a flux of 88 protons/s into the energy spectrometer. Aside from the technological problems mentioned, low magnetic and electric fields in the beam tube are also necessary; disturbing fields of less than 1 mV/cm and 1 mOe were achieved. Preliminary results are discussed. Based on the experience obtained from these experimental studies, proposals for n–n scattering and for scattering of charged particles from a neutron-gas target are discussed. The feasibility of n–n experiments with existing reactors, as well as the installation of neutron targets in storage rings, is discussed. In connection with a 20-A proton beam n–p scattering with luminosity up to $10^{31}/cm^2$ s can be performed by means of neutron targets produced from a medium-size research reactor. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstract 28766.

28728 (EUR-4653) CALORIMETRIC MEASUREMENT OF NUCLEAR HEATING IN THE HFR CORE (CADO 11-16). Kroeckel, H. (Commission of the European Communities, Brussels (Belgium)). 1971. 36p. INIS.

Measurements of nuclear heating in six representative in-core positions of the HFR are carried out at 30 MW reactor power as a joint program of the RCN Reactor Department and the Euratom HFR Development Group. The 6 rigs used in this program are equipped with 8 calorimeters each, which are of the so-called CADO type. (INIS)

28729 (EUR-4746) SUMMARY OF NUCLEAR HEATING DATA FOR THE 45MW CORE CONFIGURATION OF THE HFR. Kroeckel, H. (Commission of the European Communities, Brussels (Belgium)). 1971. 21p. INIS.

Nuclear heating data for the experimental positions of the HFR in the 45 MW core configuration are presented. The reference data for graphite are based on the results of calorimetric measurements. Conversion factors are given for the parameter sample size, filler element diameter, local power production and sample material. The influence of the control rod displacement is presented in relation to the core positions. (INIS)

28730 (EUR-4747/I) HYDRAULIC OSCILLATIONS AND TRANSIENTS IN THE HFR. Part 1. Investigations of Pressure Fluctuations. Bathe, B.; Kroeckel, H. (Commission of the European Communities, Brussels (Belgium)). 1971. 62p. INIS.

Investigations of pressure fluctuations in the primary cooling-circuit of the High Flux Reactor (HFR) at Petten are reported. The procedures used for the measurements and data analysis are described. Analog records and power spectral density distributions are presented in relation to the rate of flow, the number of operating pumps, the transducer connections and the coolant temperature. Bending oscillations of some primary system pipes are identified as the probable origin of the fluctuations. Random and intermittent excitations of these oscillations could be distinguished; the two mechanisms are attributed to flow turbulence and cavitation, respectively. (INIS)

28731 (EUR-4748) MAXIMUM POWER OF FUEL ELEMENTS AND CONTROL ROD FUEL SECTIONS IN THE HIGH FLUX REACTOR. Kreygep, P. J.; Essler, W. A.; Van De Meutter, J. (Commission of the European Communities, Brussels (Belgium)). 1971. 93p. INIS.

The maximum power of HFR fuel elements is determined on the basis of two criteria; bubble detachment heat flux density and steady-state burnout heat flux density. An important factor determining the maximum power of the fuel elements is the vertical distribution of the power which is caused by the control rod vertical position. The present analysis is restricted to a bankwise operation of the 6 control rods. The minimum control rod setting adopted is 40 cm. Expressions for the maximum power of fuel elements in different core positions and control rod fuel sections are derived from quantities which govern the bubble detachment criterion, the steady-state burnout heat flux being more elevated. The thermal transient after a complete loss of coolant flow (and the associated reactor scram) is analyzed in order to predict burnout conditions during the onset of natural convection. (INIS)

28732 (EUR-4749) CALCULATION OF VERTICAL BURNUP AND POWER DISTRIBUTIONS IN HFR FUEL ELEMENTS. Kreyger, P. J. (Commission of the European Communities, Brussels (Belgium)). 1971. 70p. INIS.

The burn-up and power distributions of fuel elements irradiated in the HFR at Petten are theoretically determined on the basis of the vertical distribution of the thermal neutron flux. Results are compared with the straight-forward calculation method of fuel management purposes. Numerical examples of burn-up and power profile calculations are presented for a fuel element and the fuel section of a control rod. (INIS)

28733 (EUR-5012) OPERATION GROUP OF THE BR2 REACTOR AND ITS ASSOCIATED FACILITIES. Annual Progress Report, 1971. (Commission of the European Communities, Brussels (Belgium); Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Aug 1973. 54p. INIS.

Operation of the BR2 and its associated installations was carried out under the Contract of Association signed between Euratom and the CEN. By the terms of this Contract, concluded in 1960 for a period of twenty years, the parties concerned use the in-

stallations, which are operated jointly, for their own purposes; they may also make them available to third parties for the latter's requirements. Implementation of the Contract is directed by a Management Committee, which met 4 times in 1971 to draw up the programs and ensure the technical coordination of the various uses to which the installations are put. Since 1963 the operation of the reactor has proved the real advantages which it derives from its unique characteristics (high flux, operational flexibility) and in particular its ability to satisfy the new requirements of experimental workers. In 1971 the help given by BR2 to the large-scale nuclear projects of the European Community was still further increased, in particular in the field of fast reactor development, which accounted for ⅔ of the total reactor utilization. (INIS)

28734 (KFK-1985) IRRADIATION FACILITIES FOR REACTOR FUEL AND STRUCTURAL MATERIALS. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). May 1974. 129p. (In German). INIS.

With figs., tabs. and refs. With abstract in English and German.

Various research projects carried out by the Karlsruhe Nuclear Research Center, especially in the field of fuel element development for the Fast Breeder Project (PSB), require in-pile experiments on fuel and structural material samples and fuel test pins. Irradiation facilities are used for this work which must satisfy the very specific and diverse requirements resulting from the respective problems at hand and which must be adapted to the conditions imposed by the respective research reactors. Such in-pile experiments are performed mainly in the FR2 reactor at Karlsruhe and the BR2 reactor at Mol. However, to a lesser extent the HFR reactor at Petten and the SILOE reactor at Grenoble are being employed. Brief descriptions are presented of irradiation facilities, most of which were designed and built by the Irradiation Technology working group in the Institute of Materials and Solid State Research (IMF). Also GEX/Mol, CEN/Grenoble, and other groups supplied a number of highly specialized systems. The individual contributions contain as many references as possible to the experience gathered in building and operating the in-pile facilities. (auth)

28735 (UNI-145) PRODUCTION TEST N-353: EVALUATION OF IN-PLACE EXTERNAL NOZZLE CAP DECONTAMINATION. Kratzer, W. K. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 15 Feb 1974. Contract AT(45-1)-1857. 8p. Dep. NTIS $4.00.

Observation of extensive external contamination on N Reactor nozzle caps being processed for re-use after removal for charge-discharge operations indicated a possibility of reducing front and rear work elevator radiation dose rates by externally decontaminating nozzle caps in-place on reactor. This production test authorizes the application of a solution of inhibited oxalic-citric acid (Turco 4521) and a solution of Wetter Water each to a separate 10 × 10 array of nozzle caps at the bottom of the N Reactor front nozzle pattern to determine the effectiveness of each in reducing radiation dose rates at the nozzles. (auth)

28736 (UNI-150(Add. 1 and 2)) N REACTOR PIPING DECONTAMINATION, 1974. Parke, J. M.; Phillips, G. H. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 8 Apr 1974. Contract AT(45-1)-1857. 106p. Dep. NTIS $8.50.

A procedure for removing fission and corrosion products from the inside surfaces of the primary front and rear piping is outlined. Turco 4512-A (70% inhibited phosphoric acid as received) in heated, demineralized water is to be used as the cleaning agent. (DG)

Propulsion and Package Reactors

Refer also to abstracts 26514, 26516, 26762, 26765–26767, 26769–26771, 26773, 26777, 26780, 26781, 26785, 26803, 26825, 26830, 26831, 26836, 27058, 27082, 27094, 27104, 27105, 27126, 27245, 28599, 28661, 28700, 28846, and 28858.

28737 (AD-776767) FEASIBILITY OF COLLOID CORE NUCLEAR REACTOR FOR ROCKET PROPULSION. Final Report. Turman, B. N.; Howard, J. M. (Aerospace Research Labs., Wright-Patterson AFB, Ohio (USA)). Dec 1973. 93p. (ARL-73-0192). NTIS $4.00.

An in-depth study has been conducted to determine the feasibility of the colloid core nuclear reactor (CCNR) for rocket propulsion. Investigations of powder containment, reactor criticality, nuclear fuel vaporization, heat transfer, and wall erosion are discussed. Results are scaled and integrated to specify an optimized design reactor rocket engine. Rocket engine performance is evaluated with respect to velocity capability, type of fuel, and fuel loss rate. It is concluded that the CCNR rocket engine is technically feasible, that a thrust-to-weight ratio of 6 : 1 is obtainable at 20,000 lb thrust, and that the maximum specific impulse cannot exceed 1020 sec. Furthermore, results indicate that the CCNR shows significant performance advantages over chemical and other nuclear rocket engines for missions requiring payloads on the order of 10,000 lb with large excess velocity capability. Recommendations are made as to the steps necessary to the further development of the colloid core nuclear reactor rocket. (GRA)

28738 (N-74-19285) DIAGNOSTICS OF SEEDED RF PLASMAS: AN EXPERIMENTAL STUDY RELATED TO THE GASEOUS CORE REACTOR. Final Report. Thompson, S. D.; Clement, J. D.; Williams, J. R. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). 11 Feb 1974. 135p. (NASA-CR-137243). NTIS $9.75.

Measurements of the temperature profiles in an RF argon plasma were made over magnetic field intensities ranging from 20 amp turns/cm to 80 amp turns/cm. The results were compared with a one-dimensional numerical treatment of the governing equations and with an approximate closed form analytical solution that neglected radiation losses. The average measured temperatures in the plasma compared well with the numerical treatment, though the experimental profile showed less of an off center temperature peak than predicted by theory. This may be a result of the complex turbulent flow pattern present in the experimental torch and not modeled in the numerical treatment. The radiation term cannot be neglected for argon at the power levels investigated. The closed form analytical approximation that neglected radiation led to temperature predictions on the order of 1000 K to 2000 K higher than measured or predicted by the numerical treatment which considered radiation losses. (auth)

28739 CRITICAL TIME FOR THE NUCLEAR SHIP. Edwards, J. (Royal Naval Coll., Greenwich, Eng.). New Sci.; 63: No. 908, 242-245(1 Aug 1974).

An evaluation of the economics of the use of nuclear ships is made. The cost per container of transport by nuclear ship as against a conventionally powered ship is considered. One of the advantages of the use of nuclear fuels in the next 20 to 30 years lies in the relative stability of nuclear fuel costs in comparison with the inevitable increasing cost of oil supplies. It is concluded that nuclear propulsion could be applied now to certain ships of 80,000 shaft horse power and above and be economically viable. A relatively well developed nuclear propulsion plant design incorporating a pressurized light water reactor, which could meet the performance requirements of the types of ship under consideration, exists. The safety problems, and the consequences of accidents, require urgent international collaboration in the technical, operational, legal, and insurance fields to enable nuclear ships to function with the degree of flexibility needed in this field of international trade. (UK)

Reactor Safety and Environmental Aspects

28740 (ANCR-1095) DETAILED TEST PLAN REPORT FOR PBF TEST SERIES PCM-20: THE BEHAVIOR OF UNIRRADIATED PWR FUEL RODS UNDER POWER-COOLING-MISMATCH CONDITIONS. Odekirk, T. G. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Apr 1974. Contract AT(10-1)-1375. 209p. Dep. NTIS $7.60.

A Test Plan is presented which provides a detailed and in-depth discussion of the first power-cooling-mismatch tests, Test Series PCM-20, to be conducted with unirradiated fuel in the Power Burst Facility. The report covers the testing sequence, measurements and instrumentation, analytical models and computer codes, and pretest calculations involved with the first test series. (auth)

28741 (ATS-TUH-1073) PREDICTION METHODS OF CONCENTRATION FIELDS OF RADIOISOTOPES AND RADIATION DOSES IN THE ENVIRONMENT OF NUCLEAR POWER PLANTS WITH EXTRAORDINARY EMISSION. Voelz, E. (Technische Univ. Hannover (F. R. Germany). Arbeitsgruppe fuer Bautechnischen Strahlenschutz). Apr 1973. 93p. (In German). INIS.

19 figs.; 10 tabs.; 40 refs. available from ZAED.

The radiation risks from radioisotopes from nuclear power plants smoke stacks and leaks are estimated. Currently used methods and formulas are listed and discussed. The formulas are evaluated in form of diagrams concerning the direct radiation out of the reactor, the outer β and γ radiation from the exhaust air plume, the exposure due to the inhalation of contaminated air, and the radiation from radioactive deposits. (GE)

28742 (CENPD-143(Rev. 1)) SAFETY RELATED RESEARCH AND DEVELOPMENT FOR COMBUSTION ENGINEERING PRESSURIZED WATER REACTORS. Program Summaries, January 1973–February 1974. Spinell, A. B. Jr. (comp.). (Combustion Engineering, Inc., Windsor, Conn. (USA)). 1974. 190p.

28743 (CONF-730907-P1, pp 411-416) ATMOSPHERIC CONTAMINATION OBSERVED AT THE CHOOZ (ARDENNES) PRESSURIZED WATER PLANT. Bertron, L.; Beau, P.; Martin, J. J. (Electricite de France, Paris). Feb 1974. (In French).

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The CHOOZ pressurized water reactor shows a contamination of primary circuit water resulting from fuel cladding ruptures. The presence of leakages inside the reactor building and the nuclear auxiliaries building gives an atmospheric contamination, especially in noble gases and, secondarily, in iodine. Waste activity and main leakage zones are evaluated. An insulation test of the reactor building showed the trapping half-life of iodine on structures in this case. Results from tests on the determination of the physical and chemical forms of iodine are given. (auth)

28744 (COO-2152-12) INVESTIGATION OF PRESSURE DROPS AND HEAT TRANSFER COEFFICIENTS FOR LOSS OF COOLANT EVALUATION. Quarterly Progress Report for Period Ending June 30, 1974. Weisman, J. (Cincinnati Univ., Ohio (USA). Dept. of Chemical and Nuclear Engineering). 1974. Contract AT(11-1)-2152. 12p. Dep. NTIS $4.00.

Progress is reported in the areas of: (1) transient pressure drop investigations, (2) two-phase pressure drop and flow pattern studies, and (3) transition boiling and reflooding heat transfer tests. (DG)

28745 (EUR-5001) PRESENT AND FUTURE SITUATION OF NUCLEAR ENERGY PRODUCTION AND ITS ASSOCIATED INDUSTRY. Normal Operation, Accident Prevention and Mitigation, Comparative Risk Assessment. Vinck, W.; Boos, H.; Luykx, F.; Maurer, H.; Van Caeneghem, J. (Commission of the European Communities, Brussels (Belgium)). Dec 1973. 60p. INIS.

An outline is presented of the present status and of the future trends in nuclear energy development in the six Member States of the European Community and in the frame of its future enlargement. Emphasis is placed upon the technical safety aspects, the siting and environmental considerations and the implications for mankind as compared to conventional hazardous industries. The radioactive effluents routinely released at present by nuclear power and reprocessing plants are investigated and the future increase estimated on the basis of: the second Community Target Nuclear Program; typical BWR and PWR releases, and the nuclear capacity installed assuming that half of it being of the PWR type and and the other half of the BWR type. It was found that only the noble gas releases in the gaseous effluent streams give rise to special supplementary precautions, justified not really by global effects through gradual buildup in the biosphere and the atmosphere, but rather by local or regional effects in the vicinity of the plants. Finally it is concluded that at present the record of the nuclear power industry is, compared to conventional hazardous industries, extremely favorable from the point of view of human injury from gaseous and effluent releases for the occupationally exposed as well as for the general public. (INIS)

28746 (GA-A-12936) SAFETY-RELATED RESEARCH AND DEVELOPMENT PROGRAMS CITED IN SECTION 1.5 OF HTGR PSARs. Biannual Report for Period Ending January 31, 1974. Tully, G. R. Jr.; Stiehl, G. L. Jr. (General Atomic Co., San Diego, Calif. (USA)). 28 Feb 1974. 47p. (GA-LTR-100).

Safety-related research and development programs concerning HTGRs are described. The research includes the core seismic program; tests of core support posts; primary coolant moisture monitor test program; startup detector development; control rod drive mechanism tests; and core auxiliary cooling system component design verification, development, and qualification tests. (JWR)

28747 (GEAP-20512) TASK B TOPICAL REPORT: EVALUATION OF DIRECT HEATERS AND HYDRODYNAMIC MEASUREMENT TECHNIQUES UNDER SIMULATED LOCA CONDITIONS IN A SINGLE-LOOP TEST APPARATUS. Muzzy, R. J.; Burnette, G. W.; Nilsson, K. A.; Sozzi, G. L.; Walker, J. P.; Wing, K. D. (General Electric Co., San Jose, Calif. (USA). BWR Projects Dept.). Jun 1974. Contract AT(04-3)-189. 253p. Dep. NTIS $7.60.

Analyses presented show that the surface conditions of a fuel pin can be simulated by a skin-heated test rod. Comparative surface temperatures and heat fluxes between a fuel pin and a test rod are shown for the same boundary conditions. Results of the analyses are used to determine the power decay in a series of single-rod and 16-rod bundle tests to demonstrate the adequacy of direct-type heaters for LOCA-type tests. The heater rods survived repeated dryout, heatup, and rewet transient tests during blowdown conditions. Test results clearly demonstrate that the thermal and mechanical performance of the direct heaters is suitable for repeated 49-rod bundle tests in the TLTA. System measurement methods are evaluated and shown to accurately describe hydraulic and thermal performance during LOCA conditions. Parametric data are presented, system sensitivity is evaluated, and the results used to establish the test plan for the 49-rod BDHT tests. A method developed for obtaining heat transfer coefficients from thermocouple measurements is applied to the post-BT region of several 16-rod bundle tests. Results from evaluation of lower bound heat transfer coefficients are compared with heat transfer performance evaluated in terms of single-phase heat transfer correlations (e.g., Groeneveld correlation for steam flow only). The measured heat transfer coefficients lie above that predicted by the correlation, using these criteria, and considerably above the IAC assumption of zero heat transfers during the "window" period. 20 references. (auth)

28748 (IRS-F-17) REPORTS ON REACTOR SAFETY RESEARCH WORK FINANCIALLY SUPPORTED BY THE FEDERAL MINISTRY FOR RESEARCH AND TECHNOLOGY (BMFT). (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Nov 1973. 272p. (In German). INIS.

With figs.

The Bundesminister fuer Forschung and Technologie (BMFT) is promoting financial plans for reactor safety research. The Forschungsbetreuung at IRS (IRS-FB) as consultants to the BMFT, provide information about the research planning. Individual reports are furnished and put into standard form by the research contractors. Each report gives information about: work accomplished, results produced, outlook on future work. The initial report for a research project describes in addition the purpose of the work. (GE)

28749 (IRS-S-10) CONTINUED FEAR FOR ALL. Answers to the Arguments in "Fortschritt fuer Alle (II)". Franzen, L. F.; Merton, A. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Jul 1973. 57p. (In German). INIS.

4 figs.; 22 refs.; with apps.

Comments on the German "Institute for Reactor Safety" and a paper entitled "Advance for All" are presented. Arguments of scientists and other experts supporting nuclear energy generation and the construction of nuclear power plants are countered. (GE)

28750 (IRS-SB-2) HYDROGEN FORMATION IN LIGHT-WATER REACTORS. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung; Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Jun 1973. 243p. (In German). INIS.

With figs., tabs., and refs. with abstract.

The current state of knowledge concerning hydrogen production in LWR's as well as other associated problems is reviewed. Thus the production of oxygen is also dealt with. An attempt is made to clarify the effect of various parameters of chemical and physical nature on the radiolysis. Furthermore, the problems of metal reactions, gamma ray absorption, and finally with the combustibility of hydrogen-air (steam) mixtures are examined. (auth)

28751 (JAERI-M-5531) LOFTY: A COMPUTER CODE FOR ANALYZING A "LOSS OF FORCED CIRCULATION" ACCIDENT OF THE MULTI-PURPOSE HIGH TEMPERATURE GAS-COOLED REACTOR. Imanishi, H.; Ezaki, M.; Mitake, S. (Japan Atomic Energy Research Inst., Tokyo). Feb 1974. 37p. (In Japanese). NTIS (US Sales Only).

The code LOFTY is used for analyzing the interdependence of thermal, nuclear, and coolant mass flow transient behavior in a "loss of forced circulation" accident of the Multi-purpose High Temperature Gas-cooled Reactor (MHTGR). It is developed by the coupling of an original hydrodynamics code of one-dimensional incompressible fluid with the code ICARUS1 used for thermal and nuclear transient analysis of the MHTGR plant. Features of the code are; (1) Thermal characteristics of plant components, reactor core, steam generator, steam reformer are analyzed by a unit cell model, and all the cooling loops are simplified into one loop. (2) In analysis of the hydrodynamics, the one-dimensional momentum equation is applied along the primary

cooling loop. (3) Primary coolant is assumed to be incompressible. (4) The thermal properties of a coolant are taken as the functions of temperature and pressure. (5) The variation in circulator head is given as input. The code is written in FORTRAN-IV Language for FACOM 230-60. (auth)

28752 (JAERI-M-5623) DIGITAL COMPUTER CODE DEPCO-MULTI FOR CALCULATING THE SUBCOOLED DECOMPRESSION IN PWR LOCA. Namatame, K.; Kobayashi, K. (Japan Atomic Energy Research Inst., Tokyo). Feb 1974. 63p. NTIS (US Sales Only).

As a part of the ROSA (The Rig of Safety Assessment) program, an effort has been made at developing a method of dealing with subcooled decompression in a PWR LOCA. As a preliminary means for analyzing the phenomenon, the digital computer code DEPCO-SINGLE was previously developed for the single-pipe calculation. Following the DEPCO-SINGLE, a digital computer code DEPCO-MULTI has been prepared for the calculation of the subcooled decompression in a multiple pipe-network such as a PWR primary coolant system. The theoretical bases and details of the code are described, and the computational results are presented and compared with the LOFT experimental values. (auth)

28753 (NP-20102) LOFT PROJECT REPORT FOR DECEMBER 31, 1973. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 24 Jan 1974. 19p.

Completion of the following tasks is reported: (1) a computer analysis to study the effect a blowdown valve delay would have on subcooled loads during a loss-of-coolant experiment, (2) construction and testing of the Loss of Fluid Test plant, instrument, and breathing air system, (3) on-dolly installation of the primary coolant system hot leg piping and the pressurizer system surge line and spray line piping, (4) fabrication of the upper and lower core support structure assemblies and flow skirt assemblies, and (5) fabrication of the primary coolant subsystem filters. (DG)

28754 (RDT-STATUS-8-74) BIMONTHLY STATUS REPORT: RDT STANDARDS. Summary as of July 31, 1974. (USAEC Division of Reactor Research and Development, Washington, D. C.). 16 Aug 1974. 45p. RSO.

28755 (RT/PROT-73-15) FRUSTA CODE DESCRIPTION. Dini, D.; Lazzeri, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1973. 29p. INIS.

The FRUSTA code computes kinematics and loading characteristics of a pipe and related restraints during the LOCA accident. Pipe behavior is assumed to be elasto-plastic. A complete listing of the program is reported together with operating instructions. (INIS)

28756 (TID-26629) PRELIMINARY PREDICTIONS OF THE FIRST PHASE OF THE LARGE SCALE MARK III PRESSURE SUPPRESSION TEST FACILITY FOR THE TWO VENT GEOMETRY WITH KEY ASSUMPTIONS AND INITIAL CONDITIONS. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div.). 13 Dec 1973. 33p.

Pretest analytical predictions for the first phase of the large scale Mark III Pressure Suppression Test are presented. Predictions are made for break sizes $2\frac{1}{8}$", $2\frac{1}{2}$", and $3\frac{3}{8}$" with 12' vent submergence, and for a $2\frac{1}{2}$" break with 8' vent submergence. All predictions are for 2 horizontal vent geometry. (DG)

28757 (UJV-3253-R) HYDRODYNAMICS OF COOLANT LOOP FAILURE IN SODIUM COOLED FAST REACTORS. Pfann, J.; Macek, J. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). 1973. 38p. (In Czech). Dep. NTIS (US Sales Only) $5.00.

Coolant flow transients in a sodium cooled fast reactor with a number of cooling loops are analyzed. The flow through the active core is divided into several parallel branches. A full range of pump characteristics has been used in the model, which makes it possible to solve the problem even in the case of flow inversion in the failed loop. The effect of check valves and manipulation of control valves can be taken into consideration. Simple analytical expressions for the description of coolant flow transients in the case of simultaneous failure of all pumps (power-supply failure) have been derived. The effect of natural circulation in the primary circuit is included. In more general cases the numerical solution must be used with the help of a computational code which is described. Some testing variants are shown together with some interesting results. (auth)

28758 (WCAP-7705(Rev.1)) TESTING OF ENGINEERED SAFETY FEATURES ACTUATION SYSTEM. Swogger, J. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Feb 1974. 64p.

The extent of on-the-line testing of the Engineered Safety Features Actuation System in a typical Westinghouse PWR plant is described. Analog channel testing is performed at the analog instrumentation channels by individually introducing dummy signals into the instrumentation channels and observing the tripping of the appropriate output bistables. The second phase consists of testing the logic and master relay circuits without actuating the slave relays. During the last phase of testing the slave relays are actuated to operate groups of final actuation devices wherever possible, without causing plant upset. As permitted by Regulatory Guide 1.22, some devices are not tested at power. Devices that cannot be actuated while the plant is on-the-line because operation of these devices would result in a plant upset are tested only through to the operation of the respective output relay contact (output blocked) with a continuity check of the final device's actuator coil circuit. (auth)

28759 (WCAP-8367) AIR TEST PROGRAM TO ESTABLISH THE COMPLETE PUMP CHARACTERISTICS OF WEMD 93A MODEL REACTOR COOLANT PUMP. Howland, G. R.; Lamers, R. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Jul 1974. 59p.

Tests to determine experimentally the hydraulic characteristics of the 93A model reactor coolant water pump are described. Air was used as the test medium. Volumetric flow to 500% design flow was applied in the normal flow direction, and 100% in the reverse flow direction. Locked rotor, free spinning, and 50%, 100%, and 200% of design speed cases were measured. The effect of fluid density was measured by setting pump outlet pressures at atmospheric pressure, 30, and 60 psia. Non-dimensional characteristics in both forward and reverse flow modes of operation were determined. Adherence to the "Affinity Laws" was examined. (auth)

28760 ACCIDENTS IN NUCLEAR POWER PLANTS AND THE PROBLEMS. Fujimoto, Y. (Waseda Univ., Tokyo). Genshiryoku Kogyo; 19: No. 9, 45-50(Sep 1973). (In Japanese).

Nuclear power generation is far from nonpolluting, and has potential hazards never experienced in conventional industries due to radioactivity. However, the building of nuclear power stations is proceeding in Japan at a rapid rate without any positive measures against environmental pollution. Inadequacy in this respect, especially in administrative circles, is expounded under the subjects of reactor accident analysis, radiation exposure processes and safe dosage. For example, the loss-of-coolant accident in light water reactors is still not well defined in its consequences. Among the routes of personal radiation exposure, intake through radioactive deposition on the ground is not considered. And the fact that any low level radioactivity is deleterious to the human body must be fully recognized. (JA)

28761 SAFETY OF ALTERATION IN A REACTOR INSTALLATION (THE ADDITION OF NO. 2 PLANT) OF CHUBU ELECTRIC POWER COMPANY'S HAMAOKA NUCLEAR POWER STATION. Genshiryoku Iinkai Geppo; 18: No. 5, 8-23(May 1973). (In Japanese).

Upon request of Chubu Electric Power Company for the alteration of its Hamaoka nuclear power station, its safety aspects have been examined by an ad hoc committee and confirmed that safety can be sufficiently secured. The results of the examination submitted to the AEC are given. The alteration in the Hamaoka nuclear power station is the addition of No. 2 plant, which is a BWR plant of heat output 2,436 MW (electric output 840 MW). Described are the following: siting conditions, reactor facilities, radiation control and normal exposure evaluation, examination on possible accidents, hazard evaluation, and engineering capability. (JA)

28762 SAFETY OF ALTERATION IN A REACTOR INSTALLATION (ALTERATION IN REACTOR FACILITY) OF SHIKOKU ELECTRIC POWER COMPANY'S IKATA POWER STATION. Genshiryoku Iinkai Geppo; 18: No. 5, 6-7(May 1973). (In Japanese).

Upon request of Shikoku Electric Power Company for the alteration of its Ikata power station, its safety aspect has been examined by an ad hoc committee and confirmed that safety can be sufficiently secured. The results of the examination submitted to the AEC are given. Revising the original plan, the supply of water is by the desalination of sea water instead of fresh water intake. The process is multi-stage flash type, and the unit capacity is 1,000 m^3/day; two units are installed. They are designed with full safety measures, and no alteration is necessary to the other station facilities. (JA)

28763 SAFETY OF NUCLEAR REACTOR PLANT. III. Uchida, H. (Tokyo Univ.). Karyoku Genshiryoku Hatsuden; 24: No. 9, 1001-1018(Sep 1973). (In Japanese).

The safety of nuclear reactor plants is discussed. In the normal operation of reactors, radioactive waste must be taken into consideration. Radioactive solution is stored in tanks until the activ-

ity partially decays then the solution is concentrated. After the measurement of activity, the solution is diluted to meet regulations, and released out of the plants. Solid waste is solidified in drum cans with concrete, and dropped in deep sea sites. Radioactive gas is stored in tanks, and forced to decay. Then, the activity is measured, and the gas is released when the activity is far weaker than the value shown in regulations. The effect of diffusion of gas is estimated by diffusion equations of air. Measures against reactor accidents are very important. The accidents due to abnormal reactivity and mechanical accidents are considered. The reactivity accidents occur due to the imposition of positive reactivity on reactor core. Reactors should be designed so as to keep negative reactivity. The most important mechanical accident is the loss-of-coolant accident. It is necessary to plan the safety program against the accident. Safety system is divided into three groups: process system, protection system, and safety devices. The process system causes the installation to be operated normally. The protection system is the mechanism which operates the safety devices automatically at the time of accident. An example of the loss-of-coolant accident is explained. (JA)

28764 MODEL FOR FUEL-COOLANT INTERACTIONS. Buchanan, D. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Phys., D (London); 7: No. 10, 1441-1457 (1 Jul 1974).

A model for fuel-coolant interactions is proposed. The interaction is divided into five stages: an initial perturbation which triggers the interaction and causes a vapour bubble to form at the fuel-coolant interface; bubble expansion and collapse with jetting; penetration of the fuel by the liquid jet; heat transfer from the fuel to the jet; the formation of a new bubble. The process repeats itself cyclically from the second stage. The most important result is that the strength of the interaction is reduced as the external pressure is increased and can be inhibited entirely if the pressure is large enough. (auth)

28765 NUCLEAR ENERGY: PANACEA OR PERIL. Blvin, H. A. (Flinders Univ. of South Australia, Bedford Park). Issue (Adelaide); 3: No. 9, 9-13(Jun 1973).

A discussion is given of the present and future utilization of nuclear energy. Fission reactors and nuclear fusion are considered. Two sources of concern are the proliferation of nuclear weapons and the maintenance of economic energy sources in the face of rapidly growing demand. (AT)

28766 ANALYSIS OF THE 1957 WINDSCALE ACCIDENT USING THE WEERIE CODE. Clarke, R. H. (Central Electricity Generating Board, Berkeley, Eng.). Ann. Nucl. Sci. Eng.; 1: No. 2, 73-82(Feb 1974).

The reactor safety analysis code WEERIE has been used to study the radiological consequences of the fire which affected a substantial fraction of the core at Windscale No. 1 pile in October 1957. From published information it has been possible to simulate the fuel conditions at the time of the incident with WEERIE and to calculate the subsequent releases of radioactive nuclides into the atmosphere. Meteorological dispersion has been estimated from the conditions prevailing at the time of the accident and WEERIE has been used to predict the dosimetric consequences, the ground deposition, and the external exposure to be associated with the release of a wide range of nuclides. Extremely good agreement has been found between the WEERIE analysis and the measurements made on a limited selection of nuclides after the incident. WEERIE additionally provides information about several other interesting facets of the Windscale release. Overall comparison with WEERIE lends confidence to the program methodology and data sources, giving increased credibility to the results obtained from the program in its application to existing and proposed commercial nuclear power stations. (auth)

28767 RECOMMENDATIONS REGARDING FIRE PROTECTION AT NUCLEAR POWER PLANTS. Stockholm; Svenska Bradfoersvarsfoereningen (1972). 46p. (In Swedish).

Normal fire hazards and the problems encountered in the traditional type of fire protection are considered. The work is done by the Swedish Fire Protection Association in collaboration with authorities and organizations concerned. The recommendations are meant for planners, designers, builders, people responsible for operation of the various parts of the plants, building authorities, and fire authorities and insurance companies. The recommendations are applicable to BWR and PWR reactors. Questions concerning design, choice of building material, ventilation, fire extinguishers, water supply and alarm systems are discussed. (SW)

28768 REACTOR SAFETY RESEARCH ON THE NUCLEAR SUPERHEAT REACTOR. Wiss., Wirt., Polit.; 4: No. 10, 7(Mar 1974). (In German).

The reactor safety research program for the nuclear superheat reactor consists of: blowdown experiments in the reactor safety containment; pressure vessel experiments; nondestructive testing methods; earthquake investigations; and leak rate determination for the safety containment. (GE)

28769 INVESTIGATION OF THE WUERGASSEN INCIDENT COMPLETED. Pressemitt. Nordrhein-Westfalen.; No. 10, 1-6(26 Oct 1972). (In German).

The experts committee for examining the incident in the KKW on April 12, 1972 has carried out detailed investigations into the cause of the incident, its course and consequences. The expert opinion clearly states (contrary to a letter of the Federal Minister of the Interior to the Committee for Home Affairs of the Bundestag — rupture of the reactor pressure vessel –) that the scram did not involve any undue stresses on the reactor pressure vessel exceeding the design specifications as a result of the temperature transient. The reactor pressure vessel has been designed to withstand several temperature transients of the kind that occurred during the incident without effect on its operational reliability. As a result of its investigations, the committee of experts recommended to reinforce the bottom plate of the pressure suppression chamber, to effectively limit the water temperature in the pressure suppression chamber, and to extend and supplement the operating instructions for the operating crew. Moreover, additional model experiments have been carried out to study the blowdown of steam into the pressure suppression chamber at high temperatures. (GE)

28770 SAFETY RESEARCH IN THE FRG. Mayinger, F. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Verfahrenstechnik). Atomwirt., Atomtech.; 19: No. 6, 288-295 (Jun 1974). (In German).

From reactor meeting; Berlin, F. R. Germany (2 Apr 1974). 9 figs.; 4 tabs.

In the German Federal Republic extensive studies on reactor safety have been carried out for all reactor concepts in question. Already in 1972, a thorough reactor safety research program for light water reactors was established which is sponsored in the frame of the 4th Atomic Program 1972/76 with a total amount of approximately 200 Mio DM. Main topics of the program are the consequences of incidents and accidents and their control with respect to the environment, the incident prevention and the removal of effects caused by incidents. The main part of these studies is devoted to the control of the effects caused by incidents. Here, especially blow-down experiments, emergency cooling experiments, and a research program on core melting are carried out. (auth)

28771 DETERMINATION OF RADIOACTIVE EFFLUENTS OF NUCLEAR POWER PLANTS. Aurand, K. (Bundesgesundheitsamt, Berlin (F. R. Germany). Inst. fuer Wasser-, Boden- und Lufthygiene). Atomwirt., Atomtech.; 19: No. 6, 296-299 (Jun 1974). (In German).

From reactor meeting; Berlin, F. R. Germany (2 Apr 1974). 4 figs.; 1 tab.

According to the Atomic Law and the 1st SSVO (radiation protection decree), radioactive wastes emanating from nuclear power plants have to be controlled completely. The principle for practical operation is to keep the radioactive wastes as low as possible. This rather vague legal term has had the consequence that reactor builders, operators and surveyors have achieved an effective quantity of radioactive wastes far below the tolerance limits. For the advanced power plants we shall probably have even smaller values. During operation, the total activity of the wastes is determined by a decisive measurement. Examinations of various waste water samples, where additionally the different nuclides were analyzed, showed that this measurement guaranteed enough safety for the environment. In order to check, or if necessary, complete the measurements done by the operator at any time, representative mix-samples of all waste water charges are kept at the operator's for one year. (auth)

Reactor Theory and Calculation

Refer also to abstract 26985.

28772 (CNEA-PMM/A-125) INTRODUCTION TO THE NUCLEAR REACTOR THEORY. Mattei, C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 27p. (In Spanish). INIS.

The principles of fission, chain reaction elemental theory of neutron diffusion, neutron energy distribution, neutronic age and control of a reactor are briefly outlined. The main ideas of reactor theory are given in a lecture as a part of an introductory course into nuclear metallurgy. (INIS)

28773 (EANDC-E-154-U, pp 1-10) REQUEST ON THE KNOWLEDGE OF ν FOR REACTOR PHYSICS. Barre, J. Y.; Reuss, P. (CEN de Saclay, Gif-sur-Yvette, France). Mar 1973.

From EANDC topical conference; Saclay, France (29 Nov 1972).

The sensitivity of design parameters to ν values is considered for the case of fast and thermal neutron reactors. The analysis is divided into three parts: effect of the absolute value of ν for standard isotopes at thermal energies; relative variation of ν with energy; relative value between two isotopes. The interpretation of integral experiments performed to improve the neutron balance also led to the establishment of the value of ν with high accuracy. The consequences of inaccuracies in ν on certain conclusions drawn from these integral experiments are discussed. Finally the current values of ν used for these integral experiments are presented together with the accuracies required for thermal or fast neutron reactors. (INIS)

28774 (FEI-371) INTEGRAL EXPERIMENTS IN FAST REACTOR PHYSICS. Reactor Physical Data Analysis with a Simple Model. Van'kov, A. A.; Voropaev, A. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 42p. (In Russian). INIS.

The basic questions of the statistical analysis of integral reactor physics data were examined. The problem on the prediction of the characteristics of reactors from experimental results and the calculation of critical assemblies was formulated and solved. Data for the BFS-22 and BFS-23 were examined as numerical examples of the analysis with the inclusion of a simple calculation model for reactors. (tr-auth)

28775 (GSF-P-53) DYNAMIC REACTIVITY MEASUREMENTS. Strube, D.; Jentzsch, U. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Physikalisch-Technische Abt.). Oct 1973. 12p. (In German). INIS.

A constant velocity rod drive method based on the solution of point model inverse reactor kinetics equations for the rapid evaluation of control rod calibration curves is described. The results are compared with calibration curves obtained by rod drop and period measurements. (INIS)

28776 (INIS-mf-1174) BURNUP PREDICTION AND SCHEMES FOR FUEL INTERCHANGE IN THERMAL REACTORS. Solanilla, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 31p. (In Spanish). INIS.

The effects of radiation on fissionable and control materials are shown along with the physical properties of the reactor, methods for calculating, and experimental techniques for evaluating space variation of the neutron spectrum. The behavior of the fuel and of absorbers is analyzed, and analytical approximations are presented for making the corresponding calculations. (TSS)

28777 (JAERI-M-5469) THERMAL CALCULATION OF THE SHORT-FUEL-PIN CAPSULES. Ando, H. (Japan Atomic Energy Research Inst., Tokyo). Dec 1973. 58p. (In Japanese). NTIS (US Sales Only).

The linear heat rating is one of the most important parameters in the irradiation of fuel capsules. Q_{pes} is obtained by nuclear calculation and experiment with a critical facility. The linear heat rating Q_{gen} is obtained from the temperature measured with thermocouples in the capsule during irradiation by one-dimensional calculation. In order to obtain the exact linear heat rating of a fuel pin, the difference between Q_{pes} and Q_{gen} must be studied. Calculation of Q_{gen}, however, is a problem because in the one-dimensional calculation the axial heat flow is neglected. The linear heat rating Q_{gen} of short fuel-pin capsules is underestimated. Two-dimensional heat transfer calculations are applied in several different capsules and the results are compared with those by one-dimensional calculations. The following were revealed: (1) For a short fuel pin (5cm in stack length and 7mm in diameter), the linear heat rating by one-dimensional calculation is 0.59 times as large as that by two-dimensional. (2) For a fuel pin of over 20cm in stack length (diameter 7mm), it becomes 0.91 times as high; the results by the two methods are in near agreement. (3) In a short and highly-enriched fuel, the peaking of heat generation occurs at the end. This is no problem because temperature peaking is very small due to axial heat flow. (auth)

28778 (JAERI-M-5557) STATUS OF BENCHMARK TESTS ON NEUTRON AND GAMMA-RAY TRANSPORT AND REACTOR KINETICS COMPUTER CODES. Asaoka, T.; Nakahara, Y.; Ise, T.; Tsutsui, T.; Nishida, T. (Japan Atomic Energy Research Inst., Tokyo). Feb 1974. 32p. (In Japanese). NTIS (US Sales Only).

The recent development of the large number of complex computer codes has resulted in the necessity of benchmark tests for the evaluation of the ability (applicability, efficiency, and precision) of computer programs. The benchmark test requires as benchmarks "exact" results with evaluated numerical errors. This means that the benchmark problem should carefully be selected to be useful to develop numerical solution techniques or error analysis methods for this special problem. Some representative computer codes to solve neutron and gamma-ray transport problems on the basis of the Monte Carlo, S_N, or diffusion methods and to deal with space-dependent reactor kinetics based on these three methods are chosen. A review is then given for various tests so far performed in different laboratories for the evaluation of these computer programs. For one-dimensional S_N codes, general conclusions are given about the best suited angular quadrature, appropriate order of angular quadrature, and total machine time required for the calculation. As a result of the review, it is seen that the benchmark problems have been set up for one-dimensional S_N codes in spherical geometry and for two-dimensional diffusion codes in rectangular geometry, so that these problems can be used also for benchmark tests. For all other fields, however, the benchmark problems should be established through studies on error analysis methods as well as the stability or reliability of numerical solution techniques. In this connection, it is urged to enlarge the range of applicability of the Monte Carlo method for obtaining benchmarks for solutions of realistic problems. (auth)

28779 (RT/FI-(74)22) STABILITY OF A NUCLEAR REACTOR: THE LYAPUNOV METHOD. Jorio, V. M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Apr 1974. 41p. (In Italian). Dep. NTIS (US Sales Only) $5.25.

An introduction to Dynamic System Theory is given. The Lyapunov's direct method is used for studying nuclear reactor stability problem. The temperature feedback on power is analyzed. The Lyapunov approach and its mechanical analog are discussed. 6 references. (auth)

28780 (RT/PROT-72-41) SOTRAN, A UNIVAC 1108 CODE TO CALCULATE POWER AND FLOW RATE TRANSIENTS IN A PULSED REACTOR. Palma, F.; Sardone, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1972. 60p. (In Italian). INIS.

A preliminary version of the SOTRAN code is presented to calculate core thermal transients due to nuclear power variations in a pulsed reactor. Classical kinetics equations including neutron sources are used to calculate the actual power and the average power in the reactor. The code is written in FORTRAN for the UNIVAC 1108. (INIS)

28781 (UJV-2975-R) METHODS OF COMPUTING REACTIVITY COEFFICIENTS OF FAST REACTORS. Pfann, J.; Dusek, J. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Jun 1973. 50p. (In Czech). INIS.

Relations are derived for a model of deformations caused in the reactor core by temperature and pressure fields. Main attention is focused on the evaluation of reactivity changes due to fuel assembly bending which results from the non-uniform distribution of heat sources in the core and from hydrodynamic forces. This relation may also be applied to strong disturbances in reactor output or in coolant flow. (INIS)

28782 EFFECT OF THE ANISOTROPIC SCATTERING ON THE THERMAL UTILIZATION FACTOR. Laletin, N. I.; Sultanov, N. V.; Vlasov, Yu. A.; Koninev, S. I. (State Committee for Utilization of Atomic Energy, Moscow). Ann. Nucl. Sci. Eng.; 1: No. 5, 333-338(May 1974).

In calculations of the thermal utilization factor for heterogeneous reactors the anisotropic scattering is taken into account usually in the transport and sometimes in the linear-anisotropic approximations. The work of Eccleston and McCormick make doubtful the generally accepted opinion that the second angular moment of the scattering kernel has little effect on the disadvantage factor in slab cells in nuclear reactors. The effects of the second and higher angular moments of the scattering kernel on the thermal utilization factor were investigated. The formulas appropriate for the qualitative analysis of the question under consideration are given and a set of cells was calculated by various methods. A disagreement between the data obtained and those reported by Eccleston and McCormick is shown. (auth)

28783 RADIOCHEMICAL DETERMINATION OF THE FAST NEUTRON FLUX IN URANIUM ASSEMBLIES. Tasa, K. S.; Attrep, M. Jr. (East Texas State Univ., Commerce). J. Inorg. Nucl. Chem.; 36: No. 8, 1699-1703(Aug 1974).

Zinc was introduced into pure uranium salt assemblies as target material for the formation of fast neutron reaction products in order to determine the fast neutron flux experimentally by means of the $^{64}Zn(n,p)^{64}Cu$ reaction. The fast neutron flux

thus determined in three samples was 0.029 ± 0.003, 0.020 ± 0.002, and 0.019 ± 0.003 n/min/gU. The fast neutron flux for these three samples was calculated from reactor theory and found to be 0.026, 0.017, and 0.017 n/min/gU, respectively. This study provides the first direct measurement by activation of the fast neutron flux present in a natural uranium assembly. (auth)

28784 MEASUREMENTS OF NEUTRON FLUXES IN STRONGLY ABSORBING GASEOUS MEDIA. Bixby, W. (Atomic Energy Commission, Washington, DC); Almenas, K. Nucl. Technol.; 23: No. 3, 213-221(Sep 1974).

Spatial neutron flux distributions have been measured in large volumes (450 liters) of several gaseous media. Measurements were made in nearly pure CO_2 having a σ_s/σ_c ratio of ~1200 and in mixtures of BF_3 and CO_2 with σ_s/σ_c ratios down to ~0.02. Thus, distributions were obtained in an almost purely scattering and purely absorbing medium. The experimental results have been processed to represent the flux distribution in a semi-infinite medium of identical composition. This required the removal of the leakage component, a correction made possible because the neutron mean-free-path of the measured media differed by several orders of magnitude. In effect, distributions determined almost entirely by neutron leakage and distributions determined almost entirely by neutron capture were directly measured. The experimental results were compared with transport theory calculational models by using several assumptions concerning the angular distribution of the neutron source flux. Satisfactory agreement was achieved between the experimental and analytical results when a purely collimated incident flux was assumed. (auth)

28785 DEVELOPMENT AND APPLICATION OF AN INTERFACE CURRENTS TECHNIQUE FOR TWO-DIMENSIONAL REACTOR CELL CALCULATIONS. Anderson, M. M. Jr. Knoxville, TN; Univ. of Tennessee (1974). 100p. University Microfilms Order No. 74-17,715.

Thesis (Ph.D.).

The interface currents, or, $J^{\pm}$ technique, is used to determine spatial flux distributions within reactor cells by coupling homogeneous cell regions to their nearest neighboring regions by assumed angular flux and current distributions at the interfaces that separate the cell regions. The computational time and computer storage required to describe this coupling is proportional to the number of cell regions. A formulation of the interface currents technique is developed for two-dimensional cell calculations. The formulation, which is applicable to arbitrarily shaped cell regions and permits the inclusion of anisotropic scattering, represents the angular interface fluxes and currents as a sum of several angular modes. The iransfer of neutrons between the angular modes is described in a systematic manner. An expansion of the angular interface fluxes in a Legendre series in terms of the angle between the neutron direction and an arbitrary direction relative to the interface normal is proposed. By comparison with a Monte Carlo calculation for a D_2O moderated cell containing an angular fuel region, a first order Legendre series (P_1) expansion of the interface fluxes about an arbitrary direction relative to the interface normal is shown to be considerably more accurate than a zero or first order expansion about the interface normal. The computation time of the interface currents technique is shown to vary significantly with the number of angular modes used to describe the interface fluxes, but remains comparable to the commonly used T_{1k} integral transport technique when three or less angular modes are used. The accuracy of the treatment of anisotropic scattering used in the interface currents formulation is demonstrated by comparison with Monte Carlo calculations under the assumption of linear anisotropic scattering. (Diss. Abstr. Int., B)

28786 PARAMETERIZATION OF GROUP CONSTANTS FOR FEW GROUP SPATIAL CALCULATIONS. Karin, S. Ann Arbor, MI; Univ. of Michigan (1973). 117p. University Microfilms Order No. 74-15,772.

Thesis (Ph.D.).

In the course of lifetime studies of light water moderated and uranium dioxide fueled reactors, the group constants, and ultimately the various energy spectrum averaged microscopic cross sections must be recalculated many times, on the order of thousands for a boiling water type reactor. This is due to local spectrum changes that arise from changes in burnup and local moderator density. To avoid redoing an entire spectrum calculation each time new group constants are required, it is desirable to parameterize the energy spectrum averages of the relevant microscopic cross sections. To the accuracy with which such averages may be performed for the thermal region by computer codes such as SOFOCATE, it was found that the results may be parameterized with three parameters: the moderator temperature T; the ratio of $\Sigma_a(kT)$ to $\xi\,\Sigma_s$, denoted by Γ; and a measure of the relative amount of absorption in plutonium 239, $\Sigma_a^{Pu^{239}}(kT)/\Sigma_a^{Total}(kT)$. Numerical results are presented and explained through the use of simple models for the thermal neutron energy spectrum. In the fast neutron energy range the cross section behavior is considerably more complex and hence the behavior of the flux is also more complex. Thus, more parameters are needed to describe the behavior of the flux. It was found that the following parameters are necessary; the water density, the uranium oxide density, the boron 10 density, the plutonium 239 density, the uranium 235 density, the uranium 236 density, the plutonium 240 density, and the fuel temperature. (Diss. Abstr. Int., B)

28787 NOISE DETECTION OF ANOMALIES IN REACTORS. Bian, S. H. Seattle; Univ. of Washington (1973). 206p. University Microfilms Order No. 74-15,558.

Thesis (Ph.D.).

The power spectral density function (PSD) and coherence function for a generalized external reactivity input to a reactor system are presented and analyzed. Through derivations and correlations, the PSD and coherence functions corresponding to anomalies due to coolant boiling, coolant flow rate fluctuations, and rod vibrations are obtained through the use of a model of point reactor kinetics and two-region temperature feedbacks. Numerical calculations are made for water cooled reactor systems with anomalies induced by nucleate boiling and by control rod vibrations respectively. Comparison of the correlated resonance PSD's in the coolant boiling case with experimental results shows that the correlation is a reasonable representation of the experimental results. A simulated calculation is attempted for sodium cooled reactor systems with anomalies induced by coolant boiling. (DG)

28788 POWER DISTRIBUTION IN FUEL ELEMENT MEAT. Ponomaev-Stepnoi, N. N.; Krutov, A. M.; Lobyntsev, V. A.; Nosov, V. I. Sov. At. Energy (Engl. Transl.); 34: No. 3, 248-250(Mar 1973).

Translated from At. Energ. (USSR); 34: No. 3, 197-198(Mar 1973).

Flattening of the power release field over the cross section of the core of a heterogeneous reactor is discussed, and some results of experimental and theoretical investigations of the power release distribution over the meat portion of fuel elements are presented. (auth)

28789 THEORY OF POWER REACTOR NOISE. II. Saito, K. (Hokkaido Univ., Sapporo). Ann. Nucl. Sci. Eng.; 1: No. 2, 107-128(Feb 1974).

The present state-of-the-art of on-power reactor noise analysis is reviewed and difficulties involved are discussed. The theoretical analysis requires not only a neutronic model but also a thermo-hydraulic model. It also depends upon the operational condition of a given reactor in certain cases. Various analyses based on the lumped model are considered. They include models with a single thermic variable, models with two thermic variables, i.e., both fuel and coolant temperature, and the more sophisticated model where coolant flow rate is taken into account. (UK)

28790 NUMERICAL SOLUTION OF THE PROBLEM OF OPTIMIZATION OF A HETEROGENEOUS REACTOR BY MEANS OF BLOCKED, BURNUP ABSORBERS. Voronkov, A. V.; Chuyanov, V. A. Sov. At. Energy (Engl. Transl.); 34: No. 6, 580(Jun 1973).

Translated from At. Energ.; 34: No. 6, 475(Jun 1973). This is a summary of paper No. 669/6884 with full copy held at TIC.

A method of solution for the problem is proposed, using as an example the solution of the problem concerned with the selection of optimal parameters for the burnup absorber guaranteeing the prescribed time development of the coefficient of utilization of thermal neutrons for a two-dimensional mesh $\Theta(X,t)$. A combined kinetic-diffusion method is utilized for the solution: the kinetic equation is solved exactly inside of the absorber and by the diffusion approximation in the remaining part of the mesh. Besides a reduction in calculation expenditures, this method allows one to localize the region of definition for an optimal change in the volume of the absorber, and, consequently, the selection of different variations also occurs in this region. A flat, nondiffusing absorber consisting of layers of different materials was utilized as an absorbing element. It was shown that the function $\Theta(X,t)$ is monotonic with respect to the individual components of the directional vector X. A modified local search method is proposed which entails the fact that progression to a minimum in $\Phi(X)$ occurs precisely on the surface of discontinuities. For this the surface of discontinuities is projected along one of the coordinates $x_k (1 \leq k \leq n)$ in a $(n-1)$-dimensional space and one of the local search methods for the function $\hat{\Pi}_k\Phi(X)$, where $\hat{\Pi}_k$ is the search operator for the minimum of the function $\Phi(X)$ corresponding to the x_k coordinate, is applied in this space. The number of calculations of the function $\Phi(X)$ (which determines the calculation time) in this case is approximately the same as that with the applica-

tion of a local method to a differentiable function of the same dimensionality. The given method was applied in the calculation of different kinds of systems, and in all cases an absolute minimum was found which was verified by a detailed study of the behavior of the function $\Phi(X)$ in the entire region of variation of the varied parameters. (TSS)

Reactor Components and Accessories

Refer also to abstracts 26717 and 27419.

28791 (INIS-mf-1256) METHODS OF ASSESSMENT FOR ASSURING RELIABILITY OF NUCLEAR POWER STATIONS. Report of a Panel Held in Vienna, 28 May–1 June 1973. (International Atomic Energy Agency, Vienna (Austria)). 1973. vp. INIS.

The object of the Panel on "Methods of Assessment for Assuring Reliability of Nuclear Power Stations" was to prepare a critical report on present practice in the field of assuring reliability of nuclear power stations, to identify the need for international collaboration in this field and to make recommendations to the IAEA in organization of these activities. The following topics were recognized as important in reviewing the present state-of-the-art in the field of assuring reliability of nuclear power stations: 1. definition of the problem; 2. management to achieve reliable performance; 3. survey of current knowledge, practices and developments. (INIS)

28792 (JAERI-M-5559) ETUDE-1: A COMPUTER PROGRAM FOR CALCULATION OF SPECTRUM AND CORRELATION OF SEISMIC RESPONSE USING FFT. Ikushima, T. (Japan Atomic Energy Research Inst., Tokyo). Feb 1974. 46p. (In Japanese). NTIS (US Sales Only).

A computer program ETUDE-1 has been prepared for analyzing seismic response of structures. Features of the program are as follows: (1) Calculable items are Fourier spectrum, power spectrum, cross-power spectrum, auto-correlation function, cross-correlation function and transfer function. (2) Numerical analysis is performed through the fast fourier transformer (FFT). (3) Any form of input data (data cards, tape, and disk) can be taken. In the case of data cards, data FORMAT is free from its format. (4) Either calculation by raw data or calculation by sine-interporated data can be performed. (5) Integral time mesh can be chosen without any restriction. (6) Calculation results can be represented with a graphic plotter. The program is written in FORTRAN IV and can be used with FACOM 230-60. (auth)

28793 (JAERI-M-5616) CODE APS-II FOR ANALYSIS OF THE PIPING STRESSES. Muto, Y. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 52p. (In Japanese). NTIS (US Sales Only).

In nuclear reactors and other industrial plants with high-pressure coolants, considerable thermal and pressure stresses are caused in the piping. The stresses and reaction forces at pipe supports present large problems in engineering. The code APS-II (Analysis of the Piping Stress-II) was prepared to study these phenomena. It is an advanced version of the code APS which calculates stresses in straight and quarter-circular piping. APS-II is capable of calculating the forces, stresses, deflections and reaction forces due to thermal expansion and internal and external pressures in piping with given numbers of straight pipes, circular pipes, supports and branches. The time required for calculation is about 1 minute. (auth)

28794 (PB-222701) IN-SERVICE INSPECTION PROGRAM FOR NUCLEAR REACTOR VESSELS. Progress Report No. 8, March 1, 1972–March 1, 1973. Reinhart, E. R. (comp.). (Southwest Research Inst., San Antonio, Tex. (USA)). 21 May 1973. 242p.

A final progress report on research and development activities related to in-service inspection of nuclear reactor pressure vessels is presented. The activities are reported under the project headings: (1) review of utility experience with coolant pressure boundary inspection, (2) development of a nondestructive test method evaluation facility, (3) investigation of the acoustic spectrometer as a semi- or fully-continuous scanning method, (4) investigation of acoustic emission techniques for continuous monitoring, (5) improvement in reliability and reproducibility of conventional ultrasonic systems for reactor inspection, (6) investigation of ultrasonic holography for visualization of flaws in thick-walled pressure vessels, and (7) collecting, reporting, and disseminating information. (DG)

28795 BEHAVIOR AND ANALYSIS OF STEEL LINERS FOR PRESTRESSED CONCRETE REACTOR VESSELS. Guerbuez, O. Ames, IA; Iowa State Univ. (1974). 143p. University Microfilms Order No. 74-15,428.

Thesis (Ph.D.).

The behavior of steel liners for prestressed concrete reactor vessels under concrete-imposed loads and subject to possible local variations is reviewed. The appropriateness of stress analysis methods used in liner design is evaluated. For stress analysis of liners, one- and two-dimensional methods of analysis are presented. In both methods the liner is considered as a separate entity, independent of the backing concrete but subject to concrete-imposed strains. In one-dimensional analysis a unit width strip of the liner together with anchors is considered. The problem is reduced to solving nonlinear (due to material nonlinearities) simultaneous equations. The solution technique is based on the initial stress approach. In two-dimensional analysis a segment of the liner plate is considered. Anchors are treated as flexible springs at discrete points. Using finite element principles, the problem is again reduced to solving nonlinear simultaneous equations. The solution technique is also based on the initial stress approach. Typical liner segments are analyzed by both methods and the results are compared. Effects of local variations are examined using the one-dimensional method for a specific design. An approximate analytical method is presented for developing the stiffness characteristics of liner panels needed in one-dimensional analysis. (Diss. Abstr. Int., B)

28796 SYSTEM AND METHOD FOR OPERATING A STEAM TURBINE WITH DUAL HYDRAULIC INDEPENDENT OVER-SPEED PROTECTION ESPECIALLY ADAPTED FOR A NUCLEAR REACTOR POWERED STEAM TURBINE. Fieglein, J. M.; Csanady, M. Jr. (to Westinghouse Electric Corp.). US Patent 3,829,232. 13 Aug 1974. Filed Date 14 Oct 1971. 14p.

In a steam turbine an overspeed protection system and method is provided which operates completely independently of the conventional steam valve controller or governor. Existing hydraulically actuated valves such as stop valves, governor valves, interceptor valves, etc., are deactivated by draining hydraulic control fluid from the aforementioned through the action of specially provided dump valves. A pair of dump valves is provided for each of the steam flow valves. Three turbine speed sensing transducers operating independently provide signals which are translated through three corresponding check circuits into related overspeed check signals. The three resulting check signals relating to overspeed are translated through majority switching logic into two dump valve trip signals. Each set of such trip signals operates one of the pair of dump valves on each steam control valve. The dump valves and hydraulic oil tanks are carefully protected from damage and any malfunction. (Official Gazette)

28797 $1/10$-SCALE MODEL TEST ON PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Onishi, S.; Kenma, Y. (Electric Power Development Co. Ltd., Tokyo). Dengen Kaihatsu K. K., Chosa Shiryo; No. 51, 122-160(Mar 1973). (In Japanese).

The $1/10$-scale model test for a gas-cooled reactor PCPV and the results are described. It is the reduced model of the PCPV for a Hinkley Point B nuclear power plant being constructed in the U. K. Experiments were carried out in two stages: within the elastic region up to design pressure 43 kg/cm^2; and up to ultimate pressure (up to rupture over the design pressure). Helical prestressing worked effectively in both horizontal and vertical directions. Vessel behavior was linear below the design pressure, being in the elastic region. The ultimate pressure is about 3.0 times as high as the design pressure. With increase of internal pressure, it exhibited sufficient plastic deformation; the rupture is gradual. Agreement was good between the behavior in the model experiment and elastic and elastoplastic finite-element analyses. The behavior of PCPV can be well predicted by the analysis assuming it as rotation-symmetric body. Overall, the PCPV behavior shown by the model was as expected; and its safety is adequate. (JA)

28798 THE MOST IMPORTANT PARAMETERS WHICH DECIDE THE BEHAVIOUR OF THE WET COOLING TOWER. Vladea, I. (Institutul Politehnic, Timisoara (Romania). Thermo-Technology). Brennst.-Waerme-Kraft; 26: No. 6, 244-249(Jun 1974). (In German).

23 figs.; 8 refs.

Besides achieving a certain cooling range, it is important for a cooling tower that this cooling range is placed at the lowest possible water temperatures. Research results have shown that to realize this requirement depends to a very large extent on the kind of cooling structures of the tower. The author shows a series of test results, achieved with various cooling packs, i.e., with plates

(for cross-flow coolers) and with different profiled rods (for cross-flow coolers). As a basis for comparisons, a cooling tower is used with assumed operation at various cooling air temperatures. (auth)

28799 STEAM TURBINES. Riess, W. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A. G., Nuernberg (F. R. Germany)). Brennst.-Waerme-Kraft; 26: No. 5, 221-223(May 1974). (In German).

105 refs.

The development of new technologies in the field of steam turbines for modern nuclear power reactors is reported. (GE)

Reactor Fuels

Refer also to abstracts 26526–26529, 27381, 27397, and 28844.

28800 (AD-775242) SOME CONSIDERATIONS OF THE MELTING OF REACTOR FUEL PLATES AND RODS. Lahoud, A.; Boley, B. A. (Northwestern Univ., Evanston, Ill. (USA). Technological Inst.). Sep 1973. Contract N00014-67-A-0356-0029. 40p. NTIS $5.00.

A preliminary analysis is presented of the gross melting of fuel plates and rods. Estimates are obtained of the extent of melting and of the rapidity with which it occurs. Analytical short-time solutions are obtained by the embedding technique. The effect of density changes are investigated. Approximate analytical long-time solutions are constructed, and the results are presented in a series of graphs. (GRA)

28801 (NIIAR-P-177) STRUCTURE FORMATION IN UO_2 FUEL ELEMENTS AND FISSION GASES RELEASE. Samsonov, B. V.; Sidorov, V. V.; Spiridonov, Yu. G.; Tsykanov, V. A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1972. 15p. (In Russian). INIS.

The process of the formation of voids in the core of UO_2 fuel elements during the operation of the reactor was examined. It was shown that the limiting stage of the process of the formation of voids is not the diffusion of UO_2 molecules through the gaseous medium of the pores, but the process of evaporation and condensation of the dioxide. The connection between the formation of voids and the release of gaseous fission products under the fuel element can was established. The assumptions on the kinetics of the release of gaseous fission products from UO_2 do not conflict with experimental data. The calculated values agree with experimental values. (tr-auth)

28802 FUEL BUNDLE WITH OFF-CENTRE ELEMENTS. Bessey, P. E.; Cooper, D. A. (to Canadian General Electric Co. Ltd.). Canadian Patent 943,675. 12 Mar 1974.

A rodded fuel bundle for use in nuclear reactors is provided having the outer row of elements or rods secured asymmetrically to the supporting end plates while utilizing initially symmetrical rods for purposes of attaching an increased number of rods of reduced diameter within existing fuel channels and utilizing existing refuelling machines. (CA)

28803 NUCLEAR REACTOR FUEL ASSEMBLY WITH COOLANT FLOW CONTROL. Tarasuk, W. R.; Yonemitsu, I. D. (to Canadian General Electric Co. Ltd.). Canadian Patent 943,674. 12 Mar 1974.

A core for a nuclear reactor of high specific power output is provided with an arrangement of fuel bundles in which at least some bundles incorporate tubular pencil elements mounted between end plates, having coolant flow restricting means secured to the bundle to control the balance of coolant flow between external flow along the outsides of the pencils and internal coolant flow within the hollow pencils. (CA)

Reactor Control Systems

28804 (EGU-05120207(Pt.1)) APPLIED RESEARCH OF THE RELIABILITY ANALYSIS OF NUCLEAR POWER PLANT CONTROL SYSTEMS. I. Kuklik, B.; Chylek, Z.; Semerad, V. (Vyzkumny Ustav Energeticky, Prague (Czechoslovakia)). 1972. 50p. (In Czech). INIS.

The algorithm of a reliability calculation of a nuclear power plant control system is described. The algorithm respects dependent disturbances. Some of the methods of reliability calculations taking into consideration the effect of correction and of renewal of individual system elements are given. The algorithm was verified by a detailed reliability analysis of the main regulator circuit of the A-1 nuclear power station. (INIS)

28805 (EGU-05120207(Pt.2)) APPLIED RESEARCH OF THE RELIABILITY ANALYSIS OF NUCLEAR POWER PLANT CONTROL SYSTEMS. II. The Information System of Operational Reliability of Nuclear Power Plant Control Systems. Chylek, Z. (Vyzkumny Ustav Energeticky, Prague (Czechoslovakia)). 1972. 43p. (In Czech). INIS.

The pre-requisites are discussed of setting up a complex reliability program of the control systems for nuclear power plants in the Czechoslovak power system. They stem from the need for a unified information system of control systems operational reliability for both nuclear and conventional power plants. The preparation of such an information system in Czechoslovak conditions is discussed. (INIS)

28806 ELECTRICAL CABLE PENETRATION FOR PCV. Sanae, S.; Sakata, H.; Onzuka, S. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Karyoku Genshiryoku Hatsuden; 24: No. 4, 361-367(Apr 1973). (In Japanese).

Cable penetrations which penetrate through the wall of primary containment vessels are the equipment through which power lines, signal lines, control lines, and like are led which are necessary to operate recirculating pumps, control rod driving mechanisms, etc. contained in the primary containment vessels. In case of manufacturing the cable penetrations, air-tight structure is the most difficult part to manufacture, though air-tightness is the most important characteristic of the cable penetrations. The air-tight structure differs according to the sorts of penetrating cables such as high tension cable, low tension cable and coaxial cable. At the cable penetration part of a primary containment vessel, a sleeve of 14B nominal diameter pipe is prepared beforehand; and a welding ring is welded to the sleeve for welding connection with the cable penetration itself. The cable penetration is inserted through the sleeve from the opposite end to the welding ring. The inserted cable penetration is welded to the sleeve as well as to the welding ring in order to make the cable penetration part to be air-tight. The cable penetrations must be subjected to a welding test, leakage test, continuity test, insulation resistance test, withstand voltage test, and pressure test before installation. (JA)

Nuclear Power Plant Economics

Refer also to abstract 28854.

28807 UTILITIES IN THE 80's: AN OVERVIEW. Mod. Power Eng.; 68: No. 6, 40-50(Jun 1974).

Panel discussions at Montreal and Toronto are reported. Economic trends in Canadian utilization of electricity are indicated, with mention of electric heating, heat pumps, and even possible electric cars. From 1990, Quebec Hydro will probably add only nuclear energy, but they are considering everything, even wind power. Quebec will use pumped water storage. New Brunswick is going ahead with a nuclear power station, but a tidal scheme is still being considered for energy storage in the Maritimes. Ontario planners are hedging their bet on nuclear power by going ahead with 4 GW of oil-fired generating capacity at Lennox and Wesleyville. They will cope with peak load by cycling their fossil-fuelled stations, by storing steam, and by pumped water storage; they are also looking at thermal storage, such as is used for home-heating in Britain. Interconnections with American utilities are almost as important as interprovincial connections. Candu reactors may be improved in efficiency, whether by thinner tubing or a hotter coolant, and organic coolant has been shelved rather than abandoned. The thorium breeder holds promise. (CA)

28808 METHODOLOGY FOR POWER PLANT SITE SELECTION AT THE RECONNAISSANCE LEVEL. Cordaro, M. C. (Long Island Lighting Co., Hicksville, NY); Malloy, W. T. Nucl. Technol.; 23: No. 3, 233-239(Sep 1974).

A methodology was developed and applied to identify the principal candidate sites at which major steam electric generating facilities to serve the Long Island area could be located. The selection criteria included not only economic and engineering considerations but social and environmental factors reflecting changing and often intangible public values. From 68 candidate sites, five were selected through a series of steps in which analysis and judgment were combined to overcome the problems of preliminary information and uncertainty. These successive steps eliminated unsuitable sites on the basis of a qualification review and a preference review. A refined analysis of the favorable sites revealed patterns of value-free dominance among them. (auth)

28809 SHORT TERM OPERATIONAL SCHEDULING STRATEGY MODEL FOR ELECTRICAL GENERATING SYSTEMS COMPOSED OF MULTIPLE NUCLEAR AND FOSSIL UNITS. Bauer, R. D.

Pittsburgh; Carnegie-Mellon Univ. (1974). 411p. University Microfilms Order No. 74-14,649.

Thesis (Ph.D.).

A model is presented which couples daily scheduling problems of meeting instantaneous power demand to longer range problems of optimally operating each nuclear unit according to schedule so as to achieve overall acceptable system operating cost both in short and long term time scales. (DG)

28810 CASE HISTORY AND EVALUATION OF A TECHNOLOGICAL DELIVERY SYSTEM: DEVELOPMENT OF COMMERCIAL NUCLEAR POWER. Dawson, F. G. Jr. Seattle; Univ. of Washington (1973). 568p. University Microfilms Order No. 74-15,423.

Thesis (Ph.D.).

The government-industry partnership that provided the institutional framework for the development of the nuclear power plant as an alternative energy source for electric power generation is examined. A technological delivery system model is employed as a focus for reviewing, analyzing, and evaluating the partnership operation. Policies, legislative actions, system processes and components, their relationships, and other aspects of the system that have affected its outcomes are considered. (DG)

28811 DECISION ON NUCLEAR SYSTEM. Elec. Rev.; 195: No. 2, 35(12 Jul 1974).

The significant advantages that the choice of the SGHWR reactor has over American LWRs for the next nuclear power station program in Britain are outlined. Briefly these are: use of natural or lightly enriched fuel; relatively simple construction; increase in design power achieved by increasing the number of pressure tubes; ease of inspection and replacement, if necessary, of all pressure parts during service; ability to operate on base load or two-shift operation, or as a load-following power station; and very high inherent safety. (UK)

28812 SURFACE STEAM CONDENSER FOR DRY COOLING. Buxmann, J. (Maschinenfabrik Augsburg-Nuernberg (M. A. N.) A. G., Nuernberg (F. R. Germany). Forschungsabteilung Dampf); Heeren, H. (Maschinenfabrik Augsburg-Nuernberg (M. A. N.) A. G., Nuernberg (F. R. Germany). Abt. Kondensatorbau). VGB Kraftwerkstechnik; 54: No. 5, 301-306(May 1974). (In German).

7 figs.; 8 refs.

The waste heat of thermal power plants with dry cooling is given off to the air. In the indirect system, water takes up the waste heat, transports it to the cooling elements in the tower and is there given off to the air. The present plants so far work with an injection condenser. The present report deals with the technical and economical effects of replacing the injection condenser by a surface steam condenser. (GE)

28813 USE OF NUCLEAR ENERGY FOR SEA WATER DESALINATION. Motoya, Y. (Public Utility Board, Yokohama, Japan). Karyoky Genshiryoku Hatsuden; 24: No. 5, 589-593 (May 1973). (In Japanese).

Though it sounds peculiar for Japan with a relative abundance of water sources, the problem of water is rising in populated, industrial areas. With the objection to dam construction by the people, and rising cost of the construction, seawater desalination by nuclear energy is becoming important. The following are described: future water demand in Japan; the process of nuclear seawater desalination; dual-purpose nuclear plants; economy of the seawater desalination; and utilization of desalinated seawater in industries. For large-scale desalination, multi-stage flash evaporation is most suitable. Then, using the steam from power-generating back-pressure turbines is advantageous in energy saving. While the cost of desalination is much higher than ordinary city water currently, the rising cost of city water will bring the desalination to comparative low cost in the future. Since water cost is an insignificant portion of the output obtained by using the water in industries, utilization of desalinated water in industries may be possible. (JA)

28814 THE NUCLEAR PROCESS HEAT ENGINEERING IS MARCHING. Wuest, H. F. Energ. Tech.; 26: No. 5, 124-125 (May 1974). (In German).

A review is given on the present activities in the fields of generation and application of nuclear process heat with emphasis on a report on the foundation of the "Arbeitsgemeinschaft Nukleare Prozesswaeme". (GE)

28815 THE LATEST DEVELOPMENT IN THE COMPETITIVE CAPACITY OF NUCLEAR ENERGY. Michaelis, H. (Commission of the European Communities, Brussels (Belgium)). Elektrizitaetswirtschaft; 73: No. 11, 294-297(May 1974). (In German).

From reactor meeting; Berlin, F. R. Germany (2 Apr 1974). 2 tabs.

At the 1973 Reactor Conference (on 12th April 1973) in Karlsruhe the competitive position of nuclear energy in the German Federal Republic and the determining factors in cost development, both for conventional energy generation and for nuclear power generation, have developed since October 1971, were discussed. Basic data were provided by the paper by B. Bergmann and H. Kraemer (KFA Juelich) "Technical and economic state in October 1971 as well as prospects for nuclear energy in power economics in the German Federal Republic" (Juel-827-HT-February 1972). The extent the determining factors for the competitive capacity of nuclear energy in the Federal Republic of Germany have changed between April 1973 and April 1974 is discussed. (auth)

Reactor Fuel Cycle Economics

Refer also to abstract 26524.

Reactor Licensing and Regulation

Refer also to abstracts 28852 and 28853.

28816 (AED-CONF-74-036-001) ENSURING THE CONSTRUCTION OF POWER PLANTS AND TRANSMISSION SYSTEMS. Bluemel, W. (Bielefeld Univ. (F. R. Germany). Fakultaet fuer Rechtswissenschaft). 1974. 36p. (In German). (CONF-731223-1). INIS.

From meeting on "How to Ensure the Energy Supply. Possible Dangers and Ways and Means to Improve Energy Supplies in the Future"; Bielefeld, F. R. Germany (7 Dec 1973).

140 refs.

A new procedure (Planfeststellungsverfahren) to be introduced in power supply legislation in order to standardize and facilitate the licensing procedure for the construction of nuclear power plants by reducing the number of authorities participating in the procedure and by drawing-up an overall schedule to be authorized and supervised by a restricted number of selected regulatory bodies is discussed. The difficulties hitherto encountered in the construction of nuclear power plants can, however, only be diminished by this new procedure, if the required modification of the current energy laws is accompanied by equally important suitable means and regulations ensuring a smooth and coordinated realization of the schedule. The discussion about the "democratization" of planning and licensing should be curtailed in order to be able to guarantee that a minimum of legal principles will equally be applied in procedures of this kind. (GE)

28817 (DOCKET-50171-174) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Semiannual Operations Report No. 70, January–June 1974. (Philadelphia Electric Co., Pa. (USA)). 28 Aug 1974. 27p. Dep. NTIS $4.50.

Peach Bottom-1 Reactor operated at power between January 5 and May 28, 1974 except for three brief shutdowns. The plant remained shutdown for the remainder of the report period to perform maintenance and surveillance testing. Return to power is expected in early July. Four spent fuel elements were shipped to ORNL for examination. Core 2 burnup as of June 30, 1974 was 818 equivalent full power days. Information is also presented on health physics and chemistry, maintenance, administrative procedures, and future activities. (FS)

28818 (DOCKET-50213-335) HADDAM NECK PLANT. Semiannual Operating Report No. 74-1, January–June 1974. (Connecticut Yankee Atomic Power Co., Hartford (USA)). 20 Aug 1974. 59p. Dep. NTIS $6.00.

Summaries are presented concerning: operations; operating procedures; shutdowns; maintenance; changes in design, specifications, and personnel; abnormal occurrences and unusual events; power generation; surveillance; coolant chemistry; waste disposal; radiation exposures; and environmental monitoring. (FS)

28819 (DOCKET-50282-278) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Semiannual Operating Report No. 2, January–June 1974. (Northern States Power Co., Minneapolis, Minn. (USA)). 30 Aug 1974. 109p. Dep. NTIS $8.25.

Information is presented concerning operations, power generation, shutdowns, maintenance, changes, tests, experiments, radioactive effluent releases, and radiological environmental monitoring. (FS)

28820 (DOCKET-50305-229) KEWAUNEE NUCLEAR POWER PLANT. Semiannual Operating Report, January–June 1974. (Wisconsin Public Service Corp., Green Bay (USA)). 30 Aug 1974. 222p. Dep. NTIS $14.25.

Information is presented concerning operation, maintenance, shutdowns, corrective maintenance on instrumentation associated

with engineering safeguards and reactor safety, primary coolant chemistry, personnel radiation exposure, summaries of airborne and liquid effluent releases, plant design changes, and reactor engineering consisting of core burnup, power histograms, and surveillance procedures. Environmental technical specifications and report on the radiological monitoring program are included. (FS)

28821 (FIND-50450-R1) FIND: SUMMIT POWER STATION, UNITS 1 AND 2. Horn, F. H. (Ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Aug 1974. 32p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

28822 (FIND-50454) FIND: BYRON/BRAIDWOOD STATIONS, UNITS 1, 2/1, 2. Williams, W. H. (Ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jun 1974. 29p. (FIND-50456). Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

28823 (GA-A-12821(Amend. 1)) PCRV DESIGN AND VERIFICATION. (General Atomic Co., San Diego, Calif. (USA)). 19 Jul 1974. 23p.

GENERAL

Civilian Defense

28824 (AD-772507/0GA) NUCLEAR EMERGENCY OPERATIONS PLANNING FOR EVACUATION OF URBANIZED AREAS (BRAVO NEOP). Volume I. Final Report. Sachs, A. (Institute for Defense Analyses, Arlington, Va. (USA)). Oct 1973. Contract DAHC20-70-C-0287. 43p. (IDA/HQ-73-15587). NTIS $3.25.

A prototype evacuation plan is described which was developed to relocate population from metropolitan areas in order to reduce casualties from the effects of nuclear weapons. The plan is concerned with emergency operations by the State and local metropolitan areas to relocate population. (GRA)

28825 MEDICAL EVACUATION OF CASUALTIES WITH COMBINED CLOSED CEREBROCRANIAL INJURIES AND RADIATION SICKNESS. Karakunev, N.; Paskalev, D.; Savov, G.; Antonov, N.; Metev, M. Voenno Med. Delo; 29: No. 1, 9-16(1974). (In Russian).

At the site of a nuclear explosion, casualties with a combination of closed cerebrocranial traumatic injuries and radiation sickness may be expected. These casualties can be subdivided into the following groups: an acute brain injury combined with acute or superacute radiation sickness caused by exposure to radiation in an amount ≧400 or ≧600 R, respectively; acute cerebral contusion and compression combined with light to medium radiation sickness (irradiation with 200 to 400 R); a medium or light brain contusion combined with light radiation sickness (irradiation with 100 to 200 R); a medium or mild cerebral contusion combined with medium or severe (acute) radiation sickness; concussion of the brain combined with mild radiation sickness; and concussion of the brain combined with medium or severe radiation sickness. The injured in group 1 cannot be transported and the prospects for their recovery are slim. It is best to leave them at the Divisional Medical Point (DMP). The casualties in group 2 should be transported from the DMP to a specialized KhPPB for wounded with injuries of the head and spinal column. Those in group 3 should be transported from the DMP to an NPPB and those in group 4 to TPPB. The injured in group 5 should be evacuated from the DMP to a NPPB or PBLR and those in group 6 to a TPPB. The injured are to be initially sorted out at a Regimental Medical Point (PMP) according to the gravity of their condition, which determines the speed with which they are evacuated to the DMP. At the DMP sorting out according to the type of injury is to be carried out to determine the kind of advanced hospital base (SKhPPB, NPPB, TPPB, or PBLR) to which the injured are to be transported from there. If a precise diagnosis cannot be made, evacuation to an SPPB should take place. Indispensable first aid is to be given at the PMP and DMP. In the case of poisoning with radioactive substances, absorbents are to be administered perorally at the DMP, intravenous injections of EDTA given there, and polyvitamin therapy begun. To facilitate diagnosis of brain injuries, a psychoneurologist should be included in the staff of DOMO (AOMO). (JPRS)

Energy Utilization and Economics

Refer also to abstracts 26756 and 26836.

28826 (ANCR-1155) IDAHO GEOTHERMAL R AND D PROJECT REPORT FOR PERIOD DECEMBER 16, 1973 TO MARCH 15, 1974. Kunze, J. F.; Miller, L. G. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 18 Mar 1974. Contract AT(10-1)-1375. 41p. Dep. NTIS $4.00.

The Idaho Geothermal R&D Project was initially charted by the Division of Applied Technology in December 1973. This report covers the first three months of activity. A brief summary is given in Section 2, with more detailed discussions in subsequent sections. (auth)

28827 (ANL-8038) HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE. Progress Report for the Period January-June 1973. Nelson, P. A.; Walsh, W. J.; Steunenberg, R. K. (Argonne National Lab., Ill. (USA)). Mar 1974. Contract W-31-109-eng-38. 60p. Dep. NTIS $5.45.

This report is the first in a series of semiannual reports on a program to develop high-specific-energy lithium/sulfur batteries for off-peak energy storage in electric utility networks. The design goals for the battery include a specific energy of 150 to 200 W-hr/kg, a specific power of 25 to 50 W/kg, and a lifetime of 5 years and more than 1250 charge-discharge cycles. The cell design that has been selected for the initial studies has upper and lower negative electrodes of a lithium-aluminum alloy, a central positive electrode containing sulfur and additives to lower the sulfur vapor pressure, and a molten LiCl-KCl eutectic electrolyte (mp, 352°C). The cell operating temperature is about 400°C. Initial cell tests have been directed toward development of a Li-Al alloy electrode, formed by electrochemical deposition of lithium on a porous substrate of aluminum fibers and a sulfur electrode consisting of a mixture of a sulfur-arsenic alloy and finely divided carbon. The cell development effort is supported by Laboratory studies, in which problems associated with cell reactions are investigated, and by materials studies, in which cell components are fabricated and new materials of construction are identified and tested to determine their corrosion resistance to the cell environment. (26 figures, 6 tables) (auth)

28828 (ANL-8058) DEVELOPMENT OF HIGH-SPECIFIC-ENERGY BATTERIES FOR ELECTRIC VEHICLES. Progress Report, August 1973-January 1974. Nelson, P. A.; Gay, E. C.; Steunenberg, R. K.; Battles, J. E.; Schertz, W. W.; Vissers, D. R.; Myles, K. M.; Webster, D. S.; Burris, L. (Argonne National Lab., Ill. (USA)). Jun 1974. Contract W-31-109-eng-38. 35p. Dep. NTIS $4.00.

This report, which covers the period from August 1973 to January 1974, describes the research efforts on a program, sponsored by the National Science Foundation, to develop a high-specific-energy lithium/sulfur battery having the performance characteristics required for powering pollution-free automobiles. The cells currently under development have negative electrodes of molten lithium and positive electrodes of iron sulfide separated by a molten lithium halide-containing electrolyte. The operating temperature of the cells is about 400°C. The performance goals for a single cell include a capacity density of 0.3 A-hr/cm^2 at a current density of 0.15 A/cm^2, a peak power density of 1 to 3 W/cm^2, and a minimum cycle life of 1000 cycles. Cells with negative electrodes of liquid lithium and positive electrodes of FeS_2-Li_2S mixtures in graphite housings achieved short-time peak power densities as high as 1.4 W/cm^2, and sustained power densities up to 0.6 W/cm^2 for ~50 sec. Capacity densities as high as 0.38 A-hr/cm^2 were achieved upon charging at a current density of 0.025 A/cm^2 and discharging at 0.1 A/cm^2. Several cells were operated for more than 500 hr and 100 cycles with only moderate declines in capacity density over the cell lifetime. Further improvements are needed in cell design to increase sulfur utilization and cell lifetime. Laboratory and materials studies in support of cell development are an integral part of the program. Recent laboratory studies have included the evaluation of support materials for the lithium electrode, investigations of the electronic conductivity of LiCl-KCl in equilibrium with lithium, and determination of the oxidation potential of metals and alloys in LiCl-KCl. The materials studies include the development of suitable electrode separators and the corrosion testing of metal and ceramic materials being considered for various cell components. (5 figures, 4 tables) (auth)

28829 (ANL-8064) HIGH-ENERGY BATTERY PROGRAM AT ARGONNE NATIONAL LABORATORY. Nelson, P.; Webster, D. S. (Argonne National Lab., Ill. (USA)). Apr 1974. Contract W-31-109-eng-38. 24p. Dep. NTIS $4.00.

Electrically rechargeable lithium/sulfur batteries are being developed at Argonne National Laboratory for use as energy-storage devices for electric utility networks and as power sources for electric automobiles. The objectives of the program to be completed by 1980 are to install a 1-MW (~50-ton) battery in a demonstration facility at an electric utility substation and to install in a test vehicle a car battery that has been built by a commercial sub-contractor. Recent work has indicated that high-temperature cells having negative electrodes of a lithium-aluminum alloy, a molten-salt electrolyte of LiCl-KCl (mp, 352°C), and positive electrodes of iron sulfide (FeS_2 or FeS) show promise of meeting the requirements of batteries both for off-peak energy storage and for electric automobiles. In a test of a full-scale (13-cm dia) Li-Al/LiCl-KCl/FeS_2 cell, a maximum specific energy of 121 W-hr/kg was attained and, in 41 cycles over a period of 1390 hr, the specific energy was 65-100 W-hr/kg. Studies of small-scale cells with FeS electrodes indicate that FeS is also a promising electrode material. The Li-Al negative electrode is less corrosive toward ceramic cell components than is molten lithium; however, studies of molten lithium electrodes are being continued because of the higher specific energy that is theoretically attainable. Materials studies are devoted to the fabrication and testing of ceramic and metallic cell components that are compatible with the cell environment and the post-test examination

of cells to aid in the design of future cells. (6 figures, 6 tables) (auth)

28830 (ICP-1054) POSSIBILITIES FOR LITHIUM BOROHYDRIDE RECYCLE. Filby, E. E. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs–Operations Office). Jun 1974. Contract AT(10-1)-1375. 27p. Dep. NTIS $4.50.

This investigation was undertaken to answer a question related to the use of lithium borohydride as a portable source of hydrogen fuel gas. Would it be possible to chemically recycle the lithium borate byproduct of the hydrogen generation reaction, and if so, how? An outline of pertinent boron chemistry shows numerous possible intermediate reaction sequences, and two apparently reasonable recycle routes. One of these uses methyl borate as an intermediate and is closest to a true cycle in that it consumes only hydrogen (and energy) and produces only water in regenerating the borohydride. The other sequence, using a diborane intermediate, is heavily favored thermodynamically (25–50% the likely energy penalty of the first route). It consumes hydrogen, carbon, and oxygen and produces water and carbon dioxide. Both routes involve individual intermediate processes which are used on an industrial scale, though not in the integrated sequences shown in this report. (auth)

28831 (LA–5596) CONCEPTUAL DESIGN OF A HEAT PIPE METHANATOR. Ranken, W. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 11p. Dep. NTIS $4.00.

A conceptual design of a unit for converting synthesis gas from coal to methane is described. Gravity-return heat pipes are used in a simple configuration that provides for removing the reaction heat from the methanation-promoting catalyst, transmitting a portion of this heat to an incoming-gas preheat section, and delivering the remainder to a steam generation unit. Problems peculiar to the use of heat pipes for this purpose are considered, and methods for solving or circumventing these problems are discussed. (auth)

28832 (LA-UR-74-1062) COMPARATIVE ANALYSIS OF LiBr ABSORPTION, DEHUMIDIFICATION AND SOLAR-RANKINE COOLING SYSTEM OPTIONS FOR A 66,000 FT^2 BUILDING IN LOS ALAMOS, NEW MEXICO. Hedstrom, J. C.; Balcomb, J. D.; Meckler, G. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 26p. (CONF-740811-2). Dep. NTIS $4.50.

From meeting of the International Solar Energy Society; Fort Collins, Colorado, USA (19 Aug 1974).

Analyses of three HVAC systems incorporating solar energy for a proposed building at Los Alamos Scientific Laboratory have been made. The proposed building, the Los Alamos Security and Resources Study Center, will consist of an office/seminar area space and areas to house the LASL main technical library. The building will have 66,000 ft^2 on three floors. The preliminary concept of the building will allow 10,000 ft^2 of solar collectors to be placed on the roof in a sawtooth pattern. The building will require humidity control between 30 to 40% relative humidity and temperature control between 70 and 75°F and hence require cooling. Each analysis consists of an hour by hour calculation using weather data from Los Alamos for a one year period. The three systems include use of heat recovery and spray units on exhaust and incoming fresh air, storage of night evaporatively chilled water, air or water cooled light fixtures and either a 200 ton absorption water chiller, a Niagara Hygrol type dehumidifier, or a Rankine cycle/vapor compression cycle unit. The computer model includes a building perimeter HVAC system and an interior HVAC system which requires year-round cooling due to the people and lighting load. The performance of all of the three systems analyzed was very good. The heating and cooling energy supplied by the solar collectors ranged from 74 to 84%. Detailed system diagrams for each option analyzed are presented. Energy flow summations for each major component are given for the heating season and the cooling season. Large energy savings due to various energy conservation features are detailed. (auth)

28833 (LBL-3066) COMPARISON OF COMPUTER PROGRAMS USED FOR MODELING SOLAR HEATING AND AIR CONDITIONING SYSTEMS FOR BUILDINGS. Graven, R. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1974. Contract W-7405-eng-48. 21p. (CONF-740811-1). Dep. NTIS $4.25.

From meeting of the International Solar Energy Society; Fort Collins, Colorado, USA (19 Aug 1974).

A comparison of the major architectural structure of computer programs available to aid in the design of solar heating and cooling systems for buildings is presented. A brief description of each program including the size, availability, inputs required, and the flow of information through the program is outlined. The equipment required to run the programs and the costs of obtaining and running the programs is summarized. "Program Notes" summarize the pertinent details required to select a computer program for educational or commercial applications. (auth)

28834 (SAND-74-0007) PELLET-TYPE THERMAL BATTERY. Bush, D. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 21p. Dep. NTIS $4.25.

A prototype thermal battery was developed which incorporates a pelletized heat source as well as pelletized depolarizer and electrolyte materials. The system used was Ca/LiCl-KCl/$CaCrO_4$. Fabrication, assembly, and test results are discussed. (12 figures) (auth)

28835 (SAND-74-0093) INTEGRATION OF PHOTOVOLTAIC AND SOLAR-THERMAL ENERGY CONVERSION SYSTEMS. Vook, F. L.; Schueler, D. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 19p. Dep. NTIS $4.00.

For optimal solar energy utilization to reduce fossil fuel consumption for residential energy needs, it is proposed to integrate photovoltaic and solar-thermal energy conversion systems to provide household electricity, hot water, space heating, and air conditioning. (auth)

28836 (SAND-74-0124) DESIGN ANALYSIS OF ASYMMETRIC SOLAR RECEIVERS. McCulloch, W. H.; Treadwell, G. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1974. Contract AT(29-1)-789. 23p. Dep. NTIS $4.25.

One of the primary distinctions among parabolic cylinder solar collectors is the focal length of the reflector. For a given collector width, this focal length is directly related to the rim angle. Previous studies have used different criteria to optimize collector designs. This study considers in detail the effects of varying the receiver design with focal length. As the rim angle is decreased, an increasing portion of the receiver and its envelope receives little or no reflected solar flux, and this portion may be designed to minimize thermal losses. The result is a design which is not symmetric about the receiver axis. The purpose of this analysis is to examine the performance of such an asymmetric receiver design and to determine the optimum rim angle. The results of the study show that, for the receiver configuration and operational conditions described, the optimum receiver has a 90° rim angle. The impact of varying a number of design parameters is also evaluated. (auth)

28837 (SLA-73-0412A) PRELIMINARY STUDY INTO THE FEASIBILITY OF A SIXTY-MINUTE THERMAL BATTERY. Bush, D. M.; Baldwin, A. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 14p. Dep. NTIS $4.00.

To investigate the feasibility of a long-life thermal battery, units were assembled with depolarizer–electrolyte–binder pellets developed especially for low-current density discharge. The battery configuration was essentially that of the 2748, which has demonstrated a thermal life exceeding 60 minutes. Fourteen batteries were tested, and the results clearly demonstrated the possibility of developing thermal batteries for life requirements in the 45- to 60-minute range. (auth)

28838 (SLA-73-5888) SIXTY-MINUTE THERMAL BATTERY: A FEASIBILITY STUDY. Bush, D.; Baldwin, A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 28p. (CONF-740908-1). Dep. NTIS $4.50.

From 9th international power sources symposium; Brighton, UK (17 Sep 1974).

An experimental unit, designated the XP60, is being used to study the feasibility of a 60-minute thermal battery. It has a pellet-type configuration, including iron–potassium perchlorate heat pellets. The electrochemical system is Ca/LiCl-KCl, $CaCrO_4$/Fe. There are twelve cells, 8.25 cm in diameter, assembled on a mandrel. Cell stack temperatures were determined by placing thermocouples in individual cells and recording the temperature during battery discharge. Thermal and electrical data are presented for specific batteries, several of which had activated lives exceeding 60 minutes. (8 figures, 3 tables) (auth)

28839 (SLA-74-5363) DEVELOPMENT AND PERFORMANCE OF A MINIATURE, HIGH-VOLTAGE THERMAL BATTERY. Clark, R. P.; Forsman, E. V. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 6p. (CONF-740805-5). Dep. NTIS $4.00.

From 9th Intersociety Energy Conversion Engineering Conference; San Francisco, California, USA (26 Aug 1974).

A miniature, high-voltage, thermally activated battery was developed at Sandia Laboratories. This battery weighs 41 grams, occupies a volume of 16.4 cm^3, and contains two separate 500-volt channels, each designed to charge a 5.25-μf capacitor within

300 milli-seconds and remain operational under a 640-kΩ load for a minimum of 28 seconds over a temperature range of +16 to +71 C. The electrochemical system utilizes a calcium anode, LiCl–KCl molten salt electrolyte, a $CaCrO_4$–K_2CrO_4 mixture as the depolarizer or active cathode material, and an iron cathode. The depolarizer and electrolyte, along with a silica binder, are formed into homogeneous pellets, and these pellets are stacked alternately with calcium–iron bimetal discs in beryllium oxide tubes to form cell stacks. The cells are activated by an iron–potassium perchlorate pyrotechnic heat source external to the BeO tubes. Significant development problems and performance characteristics are discussed. (9 figures, 5 tables) (auth)

28840 (SLA-74-5381) REVIEW OF THERMAL BATTERY TECHNOLOGY. Van Domelen, B. H.; Wehrle, R. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 6p. (CONF-740805-4). Dep. NTIS $4.00.

From 9th Intersociety Energy Conversion Engineering Conference; San Francisco, California, USA (26 Aug 1974).

The evolution of thermal battery technology from World War II to the present is reviewed. The first applied work with thermal cells, the transfer of this laboratory technology to the United States, the development of the initial cup technology by the U. S., and the evolution of this technology to the later pellet technology are discussed. (7 figures) (auth)

28841 (SLL-73-0263) SENSIBLE HEAT STORAGE IN LIQUIDS. Brumleve, T. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 41p. Dep. NTIS $5.25.

Initial investigations are presented covering several aspects of thermal energy storage as sensible heat in liquids. Heat loss to the environment from insulated tanks and underground mined cavities is characterized as a function of size, temperature difference, and time. Storage and interchange of hot and cool liquids within a single storage volume is discussed along with the advantages of preventing mixing. A technique for minimizing mixing through the use of a thermocline at the interface between hot and cool liquids is presented together with the mechanisms which degrade energy availability. (auth)

28842 (UCRL-51594) SORPTION HYSTERESIS IN THE VANADIUM–VANADIUM HYDRIDE–HYDROGEN SYSTEM. Lakner, J. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Apr 1974. Contract W-7405-eng-48. 21p. Dep. NTIS $4.00.

Equilibrium hysteresis curves for vanadium hydride and vanadium deuteride have been determined for the $\beta + \gamma$ and the β regions. The hysteresis loop in the two-phase region is significant. There is no hysteresis in the β region. For an almost fully loaded hydride, $VH_{1.9}$, the complete hysteresis loop is achieved by cooling to temperatures of approximately −85°C. A partially loaded hydride, $VH_{1.3}$, does not require as low a temperature for completion of the loop. A transient hysteresis loop for $V(HD)_{1.72}$ is also discussed. (auth)

28843 (WASH-1337-5(DRAFT)) SOLAR ENERGY PROGRAM PLAN FOR HEATING AND COOLING BUILDINGS. McGee, R. P.; Rannels, J. E.; York, C. I. (USAEC Division of Headquarters Services, Washington, D. C.). Feb 1974. 41p. Dep. NTIS $5.25.

The objectives of this program is to accelerate the development and marketing of solar heating and cooling systems for buildings, using existing technology, with a goal of achieving commercial production on a national scale within five years. (WDM)

28844 MEDIUM AND LONG-TERM ASPECTS OF NUCLEAR FUEL SUPPLY. Keltsch, E. (Preussische Elektrizitaets-A. G., Hannover (F. R. Germany)). Atomwirt., Atomtech.; 19: No. 7, 334-339(Jul 1974). (In German).

From reactor meeting 1974; Berlin, F. R. Germany (2 Apr 1974). 8 figs.

One of the main concerns of electricity economy is to ensure medium and long-term fuel supply. The potential of nuclear energy is considered. For this purpose, the uranium reserves, the production capacities of uranium mines and enrichment plants, as well as political and economical aspects affecting supply are discussed. Furthermore, it is shown how the Federal Republic of Germany as a big consumer country may contribute by means of pursuing an active raw materials policy. (GE)

Information Handling

Refer also to abstract 28859.

28845 (CONF-730907-P2, pp 1330-1336) PUBLIC CONFIDENCE IN NUCLEAR POWER. Bonnell, J. A.; Dale, G. C. (Central Electricity Generating Board, London). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Although, in the United Kingdom a healthy interest is maintained by the general public in the development of nuclear power as an energy source, concern has never been so widespread or as hostile as has been the case in the United States of America. This paper suggests reasons for this and discusses the origins of nuclear power in relation to the public and the government administrative machinery which has been built up around the subject. The method of obtaining consent to build and operate a nuclear power station is outlined and the intensive public relations exercise to which all parties contribute is put forward as a main reason why nuclear power is not only accepted by the majority but is actively encouraged. (auth)

28846 (CONF-730907-P2, pp 1337-1346) INFORMING THE PUBLIC ABOUT NUCLEAR ENERGY. Kiefer, H.; Koelzer, W.; Staeblein, G. (Karlsruhe Nuclear Research Center, Ger.). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

When the Karlsruhe Nuclear Research Center was founded in 1956, it soon became apparent that the population of the neighboring communities had to be informed about nuclear energy in an unbiased, objective way. Those discussions centered chiefly around arguments of radiation protection. The experience gained from our public relations activities in those years was used and continued by the Nuclear Engineering School of the Karlsruhe Nuclear Research Center, e.g., in special courses run for the information and education of teachers and journalists who passed this information on as opinion leaders. In a similar way it was possible to discuss the objections against siting of the first nuclear power stations in Germany with the population in the environment of those sites. It was not until the controversy imported from the United States that organized groups of the population turned up who were against the use of nuclear power. This at the same time made the arguments more emotional, expanding them into problems of energy policy and sociological questions under the headings of environmental protection. This different situation must be taken into account in public relations activities. Our experience from numerous and varied discussions with action groups against nuclear power has clearly shown that big rallies and use of the mass media can result only in general information and education of the public. More complex subjects with discussions pro and con, which arise when it comes to the establishment of a nuclear plant, need early and specific approaches to homogeneous groups. These contacts should always be supported by arguments of fact and should cover only a limited subject. (auth)

28847 (NOAA-TM-EDS-ESIC-8) SEA GRANT PUBLICATIONS INDEX, 1968–1972. Volume 1. Weedman, P. K. (comp.). (Rhode Island Univ., Narragansett (USA). National Sea Grant Depository). May 1973. Contract 2-35473. 284p.

28848 (NOAA-TM-EDS-ESIC-9) SEA GRANT PUBLICATIONS INDEX, 1968–1972. Volume 2. Weedman, P. K. (comp.). (Rhode Island Univ., Narragansett (USA). National Sea Grant Depository). May 1973. Contract 2-35473. 329p.

28849 (NOAA-TM-EDS-ESIC-10) SEA GRANT NEWSLETTER INDEX, 1968–1972. Weedman, P. K. (comp.). (Rhode Island Univ., Narragansett (USA). National Sea Grant Depository). May 1973. Contract 2-35473. 150p.

28850 (ORNL-EIS-74-62) NSF-RANN TRACE CONTAMINANTS PROGRAM DIRECTORY. Copenhaver, E. D.; Smith, S. K.; Wilkinson, B. K. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 92p. Dep. NTIS $7.75.

Law

Refer also to abstracts 27065, 27066, and 28598.

28851 (CONF-730907-P2, pp 1307-1317) LAW AND LOW LEVEL RADIATION EXPOSURE. Eason, C. F.; St. Denis, N. Y. (Atomic Energy Commission, Washington, DC). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

One of the responsibilities of the health physicist is to recom-

mend and enforce radiation protection standards based upon recognized occupational radiation exposure guides. It follows, therefore, that the health physicist, because of his background and technical knowledge, will play a key role in evaluating a claim allegedly arising out of exposure to ionizing radiation. It is the purpose of this paper to examine a number of latent radiation injury cases with particular emphasis on the kinds of radiation records offered in evidence, the nature of the expert testimony by both the health physicist and the medical expert and the conclusions of the court or Board in the final adjudication of the claim. The paper will also explore the views of those who hold that the present legal system in the United States is not appropriate for the handling of latent injury claims. (auth)

28852 PROBLEMS ENCOUNTERED IN THE RELATIONS BETWEEN THE POPULATIONS AND THE LOCAL AUTHORITIES IN TIHANGE. Haas, P. (Centrale Nucleaire, Tihange, Belgium). J. Belge Radiol.; 57: No. 2, 161-165(1974). (In French).

Relations between the promoters of the Tihange Nuclear Power Plant and the authorities and also the relations with the population are considered. In the first instance, there were no real difficulties but the second gave rise to opposition which aroused distrust and anxiety within a small fraction of the population. The promoters answered to this by giving exact and accessible information to all. (auth)

28853 NUCLEAR CONTROVERSY AND THE EVOLUTION OF THE STANDARDS APPLICABLE TO POWER REACTORS IN THE US. Hubert, E. H. (Union des Exploitants Electriques, Brussels). J. Belge Radiol.; 57: No. 2, 145-160(1974). (In French).

The complexity of the phenomena revealed by the term "nuclear contestation" and the negative, and sometimes positive, consequences of this contestation for the industrial development of the power reactors are considered. The image is not complete, owing to the extent of the fields considered: scientific, technical, economical, political, juridical, social and psychological. Some observations are included on the definition of the contestation and its deep motivations; confining to the American level, comes the history of the contestation pointing out the evolution of the themes on which it was based and the forms of action it has taken. Then follows a comment on the reactions of the different circles which are favorable to nuclear energy, and on the attitude of the public. Finally, the evolution of the standards applicable to power reactors is analyzed from the point of view of the influence that could have been exerted by the contestation. Some observations on the possibility of transposition of this contestation to Europe finish the study. (auth)

28854 SITE SELECTION OF NUCLEAR PLANTS TAKING INTO ACCOUNT OF THE REACTIONS OF THE LOCAL POPULATION. de Maere, X. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). J. Belge Radiol.; 57: No. 2, 167-170(1974). (In French).

The attitude of the public towards the nuclear risk is conditioned by various sociological, political, regional and temporary factors. Analysis of these factors is very interesting for a better understanding of certain aspects of the nuclear controversy. The case of the Studiecentrum voor Kernenergie at Mol is examined from this point of view. (auth)

28855 PUBLIC WORKS FOR WATER AND POWER DEVELOPMENT AND ATOMIC ENERGY COMMISSION APPROPRIATION BILL, 1975, NINETY-THIRD CONGRESS, SECOND SESSION, SENATE. Washington, DC; Committee on Appropriations (1974). 74p. GPO.

The 1975 appropriations bill provides funds in Title I for the AEC programs; Title II for the Departments of the Army, Civil, Corps of Engineers for the Civil Works Programs; Title III for the Department of the Interior's Bureau of Reclamation and power agencies; and Title IV for related independent agencies and commissions, including the Appalachian Regional Development Programs, TVA, and the Federal Power Commission. Water supplies are required to run hydropower, operate nuclear and fossil fuel power plants, produce food and fiber, operate navigation systems, develop oil shale deposits, and to provide municipal and industrial supplies. (MCW)

Management

Refer also to abstracts 28844 and 28846.

28856 (CONF-730907-P2, pp 864-869) NUCLEAR SAFETY ORGANIZATION IN A UNIVERSITY RESEARCH FACILITY. Kissel, P.; Renard, C. (Commissariat a l'Energie Atomique, Paris). Feb 1974. (In French).

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The CEA has been asked to furnish the university technical assistance in nuclear safety and security. The new problems posed by setting up a safety organization with the means available at a university are outlined. The details of the plans developed and tested in a university establishment are presented. (tr-auth)

28857 (CONF-730907-P2, pp 1287-1297) RADIATION PROTECTION TRAINING COURSES AT E.I.R. WUERENLINGEN, SWITZERLAND. Spiess, R.; Brunner, H. (Eidgenoessische Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Due to the increasing applications of ionizing radiations and radioactive materials and required by radiation protection laws a growing number of professions and persons need at least a basic understanding of radiation problems and some practical instruction and training in radiation protection. The vast experience accumulated in nuclear research centers in the field of radiation protection training of employees on all levels is an excellent basis for the development of training programs for most needs. The program offered by the School for Radiation Protection of EIR (Federal Institute for Reactor Research), Wuerenlingen, comprises four categories: full-time health physics personnel of all levels; professionally exposed personnel; emergency organization personnel (fire departments, police, army etc.); and students and pupils. Some typical or new courses are described in detail. The importance of such programs for improving the information and education of the public on radiation and safety matters is stressed. (auth)

28858 (CONF-730907-P2, pp 1298-1306) PROJECT TRAINING FOR GRADUATE STUDENTS IN HEALTH PHYSICS. Lakey, J. R. A.; Yorke, A. V. (Royal Naval Coll., London). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

The Royal Naval College has conducted graduate training in health physics for over 10 years and has developed a system of project training which gives students practical experience in the context of the formal theoretical course. The purpose of project training is to provide realistic radiological protection problem solving at a time when the student is consolidating his theoretical knowledge. The procedures used to introduce, supervise, and assess these projects are described. The projects are initiated early in the course by presentation of a package which includes a statement of the aims of the project, copies of relevant papers, apparatus manuals, radioactive source calibrations and guide lines for progression of the project. The student is required to write a report on his project which is presented orally and staff appraisal takes account of all aspects of the student's project work. The success of this approach was evaluated against the cost in staff and equipment resources required to achieve realistic and effective training. (auth)

28859 (CONF-730907-P2, pp 1318-1329) RADIATION PROTECTION INFORMATION AND EDUCATION FOR THE PUBLIC: MISTAKES AND LESSONS, STRATEGIES AND TACTICS. Brunner, H. (Eidgenoessische Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Feb 1974.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

Radiation protection and nuclear safety have become major targets for attacks by critics and opponents of many sorts. Methods for coping with such challenges and avoiding wasting time or forces are considered. By learning from past mistakes and analysis of the situation appropriate tactics and strategies can be developed that take care of the immediate needs and set some long-range goals for improved information and education of the public. Characteristics and problems of using or cooperating with news media are discussed and some proposals for actions by IRPA and its affiliated societies are presented. (auth)

Mathematics and Computers

Refer also to abstracts 27106, 27138, and 27144.

28860 (ANCR-1156) MOCUS: A COMPUTER PROGRAM TO OBTAIN MINIMAL SETS FROM FAULT TREES. Fussell, J. B.; Henry, E. B.; Marshall, N. H. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Aug 1974. Contract AT(10-1)-1375. 42p. Dep. NTIS $4.00.

The report is the user's manual for MOCUS, a computer program for obtaining minimal cut sets and minimal sets from fault trees. The major algorithm used in MOCUS is presented. The input and output of the program are described. (auth)

28861 (CONF-730907-P1, pp 112-116) COMPUTER-ASSISTED LASER HAZARD CALCULATIONS AND A CRITICAL ANALYSIS OF THE PREDICTION EQUATIONS. Cornelius, W. A.; Leith, I. S. (Australian Radiation Lab., Melbourne). Feb 1974.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

In proceedings of the third international congress of the International Radiation Protection Association.

A computer program for laser hazard calculations with graphical output over the hazardous range is described. The assumptions implicit in the prediction equations in frequent use are examined and anomalies suggested. (auth)

28862 (LA-UR-74-761) OVERVIEW OF A COMPREHENSIVE COMPUTERIZED PROJECT COST AND SCHEDULE EVALUATION SYSTEM. Orr, H. D.; Forrest, R. P.; Stutz, R. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 5p. (CONF-741011-1). Dep. NTIS $4.00.

From 1st international cost engineering symposium; London, UK (6 Oct 1974).

The impact of development, acceptance, and use of computers into an area of business such as Project Cost and Schedule Evaluations is discussed. (MCW)

28863 (ORNL-4981) TOLERANCE FACTORS FOR THE TWO-PARAMETER EXPONENTIAL DISTRIBUTION. Patil, S. A.; Uppuluri, V. R. R. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 24p. Dep. NTIS $4.00.

The tolerance limit factors based on the assumption of a Gaussian distribution of the underlying phenomenon were used to find tolerance limits for some data on ultimate yield strength of hafnium ingots. Gaussian tolerance factors also were used in connection with the crack length on the studs in a high flux isotope reactor. Not much is known about the tolerance factors for other distributions with location and scale parameters. In some situations the assumption that the underlying phenomenon has an exponential distribution may be more realistic than that of a Gaussian distribution. In the case of a two-parameter exponential distribution, the theoretical aspects of the β-content tolerance factors, motivated from best tests, are investigated. Formulae for the β-content upper and lower tolerance factors that are amenable for computation are obtained. For comparison, previous corresponding formulae for the β-expectation tolerance factors are obtained. (MCW)

28864 (ORNL-TM-4645) SUBODF: A FORTRAN CALLABLE DECSYSTEM-10 PROGRAM TO GENERATE AND QUEUE A JOB STREAM (CARD DECK) TO TOE IBM 360 COMPUTERS. Craven, J. G. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 41p. Dep. NTIS $5.25.

SUBODF is a DECsystem-10 assembly language program used to build and queue job streams from the PDP-10 computer to the IBM 360 computers. Input to the program can be from the user's teletype or disk files. Disk files containing ASCII characters, floating point, or integer data can be included in the job stream. Disk files written using the FORTRAN binary format or ORELA Data Format, ODF, can be included in the job stream. SUBODF can be run as a program or called as a subroutine. (auth)

28865 (UCID-15589) LRLTRAN LANGUAGE. Zwakenberg, R. G.; Ranelletti, J. E.; Martin, J. T.; Hughes, R. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Nov 1969. 16p. Dep. NTIS $4.00.

The requirement for language compatibility among a large number of different computers has led to the need for a high-level programming language. The machine language programmer may forfeit vaunted high-level language advantages such as application-oriented notation and machine independence. Because of the requirement for numerical notation and computation, the language chosen, LRLTRAN, was based upon FORTRAN. The primary goals of LRLTRAN were the flexibility and open-endedness of the language, which is adaptable by the user. The notation for doing numerical computation is well defined and best understood, so therefore, that part of the language seldom requires change. To be flexible, the language is designed with an eye for additions and modifications to the noncomputational language area. To facilitate the requirement for machine independence, the LRLTRAN compiler itself was programmed in LRLTRAN. This allowed for a bootstrapping process of the compiler. The total translation process of the compiler is divided into two distinct phases: (1) an earlier completely machine-independent one that translates programs from source language into an intermediate representation and (2) a later one, oriented to some particular machine, that carries the program from intermediate to machine language. The LRLTRAN language is meeting its goals of being useful through diversified programming efforts and allowing machine independence to the programmer. The flexibility and open-endedness of the language has been proven by the ease that additions and modifications have been made and are continuing to be made. (auth)

28866 (UCID-15768) GENERAL DESCRIPTION OF THE OPERATION OF THE COMPUTER CODE STROMBOLI. Rater, O. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Dec 1970. Contract W-7405-eng-48. 50p. Dep. NTIS $5.50.

STROMBOLI is a code used to design equalizers for coaxial cable equalization. The code has a number of input options which specify the cable and (in some options) the equalizer. The output consists of: (1) equalizer; (2) performance of the design operation; and (3) performance of the equalizer as compared to the cable. A card deck and input description are available from the author for the batch-processing form of the code. The special routines used include BAPO, SOUR, STRATO (file name STRA), REPL, ZERO, FCODE, HCODE, FARADS, and CMPPLT. (MCW)

Miscellaneous

28867 (ANCR-1138) LOW TEMPERATURE DEMONSTRATION GEOTHERMAL POWER PLANT IN THE RAFT RIVER VALLEY. Kunze, J. F.; Miller, L. G.; Neill, D. T.; Nichols, C. R. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Apr 1974. Contract AT(10-1)-1375. 52p. Dep. NTIS $5.45.

The potential of geothermal energy in satisfying the nation's energy needs depends in part on the size and extent of hydrothermal reservoirs and on the economics of extracting energy from such reservoirs to be converted to electric power. The Raft River Project will study the techniques (by actual testing) of utilizing water at temperatures well below what is now considered the commercially viable range. Geochemical indicators show reservoir temperatures of less than 150°C (302°F). Environmental conditions will be a major consideration in this project, and will include the re-injection of all waste geothermal fluids without contaminating the abundant near-surface aquifer. (auth)

28868 (BNWL-SA-4941) PARTICLE AND GASEOUS REMOVAL IN THE ATMOSPHERE BY DRY DEPOSITION. Sehmel, G. A.; Hodgson, W. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1974. Contract AT(45-1)-1830. 10p. (CONF-740922-8). Dep. NTIS $4.00.

From symposium on atmospheric diffusion and air pollution; Santa Barbara, California, USA (9 Sep 1974).

Airborne pollutants are removed from the atmosphere by dry deposition. Removal fluxes are dependent on airborne concentrations, particle diameter, deposition surface, and meteorological conditions. In literature descriptions of field experiments, deposition rates were characterized in terms of a deposition velocity, v_d. The term v_d is an overall mass transfer coefficient that includes effects of both surface resistance in the lower 1 cm adjacent to the deposition surface as well as transport resistance from the pollutant concentration measurement height to 1 cm. In these field experiments, deposition velocities, v_d were evaluated using particles with relatively wide size distributions for deposition velocity measurements. Since deposition velocities are dependent on particle diameter, quantities v_d describe deposition rates only for particle size distributions used in the field determination of v_d. In contrast, deposition velocities, K, have been evaluated in wind tunnel experiments using single sized particles and including only surface mass transfer resistance. Deposition velocity data, K, were examined by least squares techniques in order to composite the wind tunnel data to obtain a dimensionless general mass transfer resistance correlation as a function of particle size, surface characteristics, and wind parameters. Deposition velocities predicted from the correlation are presented in terms of a three-box model that considers diffusional resistance adjacent to a surface. (auth)

28869 (LA-5595-MS) PRELIMINARY STUDY OF THE QUALITY OF WATER IN THE DRAINAGE AREA OF THE JEMEZ RIVER AND RIO GUADALUPE. Purtymun, W. D.; West, F. G.; Adams, W. H. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 26p. Dep. NTIS $4.00.

A preliminary study of the quality of surface and ground water was made in the area of a proposed geothermal test hole and experiment by Los Alamos Scientific Laboratory. The study was made to establish background data prior to the geothermal ex-

periment by the Laboratory. The data compiled prior to 1971 were taken from a literature search while data from 1971 through 1973 were collected from field surveys. Analyses are reported from 17 surface water stations, 15 mineral and thermal springs, and 53 ground water stations (wells, test holes, and springs). A general description of sampling stations is presented with a brief description of the chemical quality of the water based on concentrations of dissolved solids. Additional water quality data will be collected prior to, during, and after the experiment. (auth)

28870 (ORNL-UR-117(Vol. 1)) COMPONENTS OF CHANGE FOR THE ADULT POPULATIONS OF CITIES BY AGE, SEX, AND COLOR. Volume I. New England. Ritchey, P. N.; Bishop, B. L. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. 87p. Dep. NTIS $7.50.

In nine volumes, estimates are tabulated of population change by age, sex, and color for 1,905 incorporated cities which had 10,000 or more inhabitants in 1970 and 2,500 or more inhabitants in 1960. Presented for each city are the 1970 population, the change in population between 1960 and 1970, net migration from 1960 to 1970 for the 1960-bounded city, and the 1970 population in areas annexed during that decade. These data are provided for the population 10 years old and over in 1970 by age, sex, and color. Corresponding figures for the 1960 population and for deaths within the 1960 boundaries of the place can be derived by simple arithmetic. To facilitate comparisons and handling, the volumes are organized by Census Divisions. The data for individual places are contained in tables that present the following: (1) net migration by age, color and sex; annexation by age, color and sex (cities with whites and nonwhites in annexed areas); (2) net migration by age, color and sex; no annexation (cities that did not annex); (3) new migration by age, color and sex; white annexation by age and sex (cities with only whites and annexed areas) and (4) net migration by age, color and sex; nonwhite annexation by age and sex (cities with only nonwhites in annexed areas). Volume I is a summary of the cities in New England states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. (MCW)

28871 (ORNL-UR-117(Vol. 2)) COMPONENTS OF CHANGE FOR THE ADULT POPULATIONS OF CITIES BY AGE, SEX, AND COLOR. Volume II. Middle Atlantic. Ritchey, P. N.; Bishop, B. L. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. 257p. Dep. NTIS $16.00.

Data are presented for the components of change for the adult populations of cities in the Middle Atlantic states of New Jersey, New York, and Pennsylvania. (MCW)

28872 (ORNL-UR-117(Vol. 3)) COMPONENTS OF CHANGE FOR THE ADULT POPULATIONS OF CITIES BY AGE, SEX, AND COLOR. Volume III. East North Central. Ritchey, P. N.; Bishop, B. L. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. 464p. Dep. NTIS $26.25.

Data are presented for the components of change for the adult populations of cities in the East North Central states of Illinois, Indiana, Michigan, Ohio, and Wisconsin. (MCW)

28873 (ORNL-UR-117(Vol. 4)) COMPONENTS OF CHANGE FOR THE ADULT POPULATIONS OF CITIES BY AGE, SEX, AND COLOR. Volume IV. West North Central. Ritchey, P. N; Bishop, B. L. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. 204p. Dep. NTIS $13.25.

Data are presented for the components of change for the adult populations of cities in the West North Central states of Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota. (MCW)

28874 (ORNL-UR-117(Vol. 5)) COMPONENTS OF CHANGE FOR THE ADULT POPULATIONS OF CITIES BY AGE, SEX, AND COLOR. Volume V. Mountain. Ritchey, P. N.; Bishop, B. L. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. 99p. Dep. NTIS $8.00.

Data are presented for the components of change for the adult populations of cities in the Mountain states of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming. (MCW)

28875 (ORNL-UR-117(Vol. 6)) COMPONENTS OF CHANGE FOR THE ADULT POPULATIONS OF CITIES BY AGE, SEX, AND COLOR. Volume VI. Pacific. Ritchey, P. N.; Bishop, B. L. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. 278p. Dep. NTIS $17.00.

Data are presented for the components of change for the adult populations of cities in the Pacific states of Alaska, California, Hawaii, Oregon, and Washington. (MCW)

28876 (ORNL-UR-117(Vol. 7)) COMPONENTS OF CHANGE FOR THE ADULT POPULATIONS OF CITIES BY AGE, SEX, AND COLOR. Volume VII. South Atlantic. Ritchey, P. N.; Bishop, B. L. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. 233p. Dep. NTIS $14.75.

Data are presented for the components of change for the adult populations of cities in the South Atlantic states of Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia. (MCW)

28877 (ORNL-UR-117(Vol. 8)) COMPONENTS OF CHANGE FOR THE ADULT POPULATIONS OF CITIES BY AGE, SEX, AND COLOR. Volume VIII. East South Central. Ritchey, P. N.; Bishop, B. L. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. 123p. Dep. NTIS $9.25.

Data are presented for the components of change for the adult populations of cities in the East South Central states of Alabama, Kentucky, Mississippi, and Tennessee. (MCW)

28878 (ORNL-UR-117(Vol. 9)) COMPONENTS OF CHANGE FOR THE ADULT POPULATIONS OF CITIES BY AGE, SEX, AND COLOR. Volume IX. West South Central. Ritchey, P. N.; Bishop, B. L. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. 216p. Dep. NTIS $14.00.

Data are presented for the components of change for the adult populations of cities in the West South Central states of Arkansas, Louisiana, Oklahoma, and Texas. (MCW)

Chemistry

28879 (MLM-2162(OP)) TSP METHOD FOR THE DETERMINATION OF INERT GAS IN GASEOUS MIXTURES. Black, J. N. (Mound Lab., Miamisburg, Ohio (USA)). 1974. 7p. (CONF-740553-1). Dep. NTIS $4.00.

From Damsul committee meeting; Kansas City, Missouri, USA (16 May 1974).

A titanium sublimation pump (TSP) method was developed for the determination of helium in active gas mixtures. Although helium has been used for most of this work, the method is equally applicable to other inert gas determinations. The method utilizes the chemical gettering action of titanium to separate chemically active gases from inert gases. A simple pressure–volume–temperature (PVT) calculation is used to determine the mole percent of inert gas present in the mixture. A mass spectrometer is interfaced directly to this system, and can provide verification of the composition of the residual inert gas following each determination. (JRD)

28880 (ORNL-TIRC-74-1) TOXICITY AND ANALYSIS OF CARBON DISULFIDE: AN ANNOTATED BIBLIOGRAPHY. Beauchamp, R. O. Jr. (Toxicology Information Response Center, Oak Ridge, Tenn. (USA)). May 1974. 73p. Dep. NTIS $7.00.

An annotated bibliography of 339 references on the analytical methods, toxic effects on humans and animals, and other environmental effects of carbon disulfide is presented. The references were obtained by a search of Biological Abstracts: Vol. 48: 1967 to Vol. 56(3): August 1, 1973, Chemical Abstracts: Vol. 56: 1962 to Vol. 79(9): September 3, 1973, Toxicology Information Response Center's Library and Files, and TOXLINE Data Base: As of September 1973. Terms searched: Carbon Disulfide and Carbon Bisulfide. (JRD)

28881 (UCID-15387) HIGH INTENSITY ARC AS A TOOL FOR EXTRACTING METALS FROM ORES. Bichenall, C. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Oct 1968. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

A high intensity arc process is described which delivers energy directly to the reacting ore materials, with only a small fraction being dissipated into the surrounding atmosphere. Containers are not heated in contact with the process stream. Some energy is wasted in vaporizing the conducting material which is mixed with the ore to form a conducting electrode. This material, however, often will be the active reducing agent (for example, graphite). A continuous process feeds the raw material in the form of electrodes together with a constant energy supply and converts the material to a product that is as close as possible to its desired final form. (JRD)

28882 (UCID-15648) REAL-TIME COMPUTER PREDICTION OF ENDPOINTS IN CONTROLLED-POTENTIAL COULOMETRY. Supplementary Information on the Digital and Analog Systems. Stephens, F. B.; Jakob, F.; Rigdon, L. P.; Harrar, J. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 May 1970. 22p. Dep. NTIS $4.25.

Information concerning the digital computer program and analog hardware developed for predicting endpoints and determining electrolytic rate constants in controlled-potential coulometry is presented. Detailed descriptions of the digital computer software and the analog system are given along with directions for setup and calibration. (JRD)

28883 (UCID-15673) DETERMINATION OF TOTAL ISOCYANATE IN TOLUENE DIISOCYANATE DIMER. Lim, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jun 1970. 10p. Dep. NTIS $4.00.

A volumetric method for the determination of isocyanate in toluene diisocyanate dimer is described. An excess of dibutylamine in o-dichloro-benzene is added to the sample and refluxed at 180 C for 90 minutes. The unreacted amount of dibutylamine is determined by back-titration with standardized hydrochloric acid. (auth)

Life Sciences

28884 (AE-489(Vol.3)) BIBLIOGRAPHY ON BONE MORPHOMETRY AND DENSITOMETRY IN MAN. Horsman, A.; Simpson, M. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1974. 114p. Dep. NTIS (US Sales Only) $8.75.

Some 1500 references to publications from the world literature that discuss techniques for the assessment of the human skeleton are presented. Emphasis is placed on methods for bone mineral measurements. (CH)

28885 (LA-tr-74-27) WORLD'S PRESENT AND FUTURE RESOURCES OF PROTEIN AVAILABLE FOR HUMAN NOURISHMENT, AND THE POSSIBILITIES FOR UTILIZING THESE RESOURCES. Pion, R.; Fauconneau, G. (Institut National de Recherches Agronomiques (INRA), 78-Jouy-en Josas (France). Station Centrale de Physiologie Animale). 1974. Translated from pp 3-59 of STI/PUB-161. (CONF-670852-1). 75p. Dep. NTIS $6.75.

From symposium on the use of isotopes in studies of nitrogen metabolism in the soil-plant-animal system; Vienna, Austria (28 Aug 1967).

28886 (ORNL-tr-2848) ALGAL CANCER AND ITS CAUSES. II. Separation of Carcinogenic Compounds From Sea Bottom Mud Polluted by Waste of the Coal Chemical Industry. Ishio, S.; Nakagawa, H. Translated by H. Kubota from Nippon Suisan Gakkaishi; 38: No. 6, 571-576(1972). 9p. Dep. NTIS $4.00.

The mud accumulated at the sea bottom off Ohmuta River clearly demonstrates a carcinogenic effect on Asakusa nori (Poryphyra tenera). The ether extract of this mud was divided into the acidic, basic, and neutral fractions, and the carcinogenic effects of these fractions on young shoots of Asakusa nori were tested. Carcinogenic property was found in the basic and neutral fractions, and it was concluded that the neutral fraction of the mud extract is the prime carcinogenic factor. This neutral fraction was separated into its components by thin layer chromatography using a 5% gypsum in silica gel stationary phase and a 19:1 n-hexane-ether developing solvent. When the individual components were tested, the components with Rf 0.20 and 0.82 were found to demonstrate definite carcinogenic activity. (auth)

Materials

28887 (AED-CONF-74-089-020) ELECTRON SPIN POLARIZATION, AT FERROMAGNETIC SINGLE CRYSTALLINE, NICKEL SURFACES DETERMINED THROUGH ELECTRON CAPTURE BY SCATTERED DEUTERONS. Rau, C.; Sizmann, R. (Muenchen Univ. (F. R. Germany). Sektion Physik; Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 1974. 9p. (CONF-740451-1). INIS.

From spring meeting of the Arbeitsgruppe Festkoerperphysik of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

2 figs.; 2 tabs.; 16 refs. With abstract.

A beam of 150 keV deuterons is scattered at grazing incidence by a nickel single-crystal surface (hkl) placed in a magnetic field. Polarized electrons captured by the scattered deuterons can orient the deuteron nuclei via hyperfine interaction. Their polarization is then a measure of the original electron polarization and is determined from the angular distribution of the alpha-particles emitted in a $T(d,n)^4He$ reaction. The electron spin polarization is found to be parallel to the magnetizing field in the nickel at (100)[110], (110)[110], (111)[anti21], and (111)[110], antiparallel in (120)[anti210]. The symbols in the brackets indicate the beam direction, the magnetization being in the plane and perpendicular to the beam direction. An electron spin polarization of $(96.1 \pm 2.8)\%$ is found at the (110) surface, other surfaces giving as yet lower values. (orig.)

28888 (AED-CONF-74-183-004) MOESSBAUER EFFECT STUDIES CONCERNING THE MAGNETIC PROPERTIES OF HOMOGENEOUS AND SUPERSATURATED GOLD–IRON-MIXED CRYSTALS. Nagorny, K.; Soia, F. (Hamburg Univ. (F. R. Germany). Inst. fuer Physikalische Chemie). 1974. 7p. (In German). INIS.

From 73rd general meeting of the Deutsche Bunsengesellschaft fuer Physikalische Chemie e.V.; Kassel, F. R. Germany (23 May 1974).

26 figs.

The magnetic properties of AuFe mixed crystals, in particular the changes of the magnetic states at various temperature treatment and with the resulting precipitations have been investigated by means of Moessbauer spectroscopy. (HK/LH)

28889 (INIS-mf-1350) DENSITY DEVELOPMENT OF THE THERMAL CONDUCTIVITY COEFFICIENT OF CARBON DIOXIDE AND KRYPTON. Snel, J. A. A. (Amsterdam Univ. (Netherlands)). 3 Oct 1973. 156p. (In Dutch). INIS.

The density coefficients of thermal conductivity were determined with an accuracy of a few percent whereas the coefficient of the thermal conductivity itself could be measured with a precision of two per mill. Special attention is focused on the higher density terms of the generalized Boltzmann equation and on the density expansion of the transport phenomena. Three classical methods for the measurement of thermal conductivity were described. It was concluded that the hot wire cell is the best apparatus to perform measurements at constant temperature as a function of density in a reasonably short time. In order to obtain a maximum accuracy the various corrections were analysed mathematically. The contribution to the heat transport due to convection in the hot wire cell is roughly 50% of the contribution in the theoretical model of two infinite vertical plates at uniform temperatures. A description is given of the measurements and the behavior of the thermal conductivity of CO_2 and Kr at amagat densities up to 100 and at temperatures between 25 and 75°C. An important conclusion is that there is no evidence of the logarithmic term. The values of the first density correction are compared with calculated values according to the theories of Enskog, Choh, and Uhlenbeck (applied to rigid elastic spheres) and Hoffman and Curtiss (Lennard-Jones (6-12)-potential). (tr-auth)

28890 (KF-1-73) TUNNEL EFFECT IN $Al-Al_2O_3-Al$ THIN FILMS. Buget, U.; Sencer, O.; Turek, D. (Ankara Nuklear Arastirma Merkezi (Turkey)). Mar 1973. 25p. (in Turkish).

The current mechanism in $Al-Al_2O_3-Al$ thin films was investigated and found due to thermionic emission and due to quantum mechanical tunnel effect at low voltage and intermediate voltage ranges respectively. The potential barrier is being determined as 1.2 eV by the comparison of tunnel region and the theory based on the rectangular potential barrier model. (tr-auth)

28891 (LBL-2731) ANTIPHASE DOMAINS AND SUPERLATTICE SPOT SPLITTING IN Cu_3Au I. Sinclair, R.; Thomas, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 17p. (CONF-740459-1). Dep. NTIS $4.00.

From meeting on studies of lattice distortions and local atomic arrangements by x-ray, neutron and electron diffraction; Juelich, F. R. Germany (29 Apr 1974).

Lattice imaging by high resolution electron microscopy was utilized in the study of antiphase boundaries and antiphase domains in Cu_3Au(I). A displacement of half the (100) fringe spacing characterises the antiphase boundary and, by following the trace of (100) fringes from one ordered domain to another, the relative phase of adjacent domains was established. The technique has shown that the discrete ordered domains formed in the early stages of ordering in Cu_3Au(I) are in small groups in which adjacent domains are in antiphase, with good correlation between the antiphase domain separation and the splitting of superlattice reflections in the corresponding diffraction patterns. It has also provided direct evidence that small regions of relatively high local degree of order (microdomains) exist in the disordered alloy. (auth)

28892 (NYO-1158-42) ELECTRON SPIN RELAXATION IN COPPER TUTTON SALTS AS STUDIED BY DYNAMIC POLARIZATION. Clarkson, R. B.; Turkevich, J. (Princeton Univ., N. J. (USA). Frick Chemical Lab.). [nd]. 55p. Dep. NTIS $5.75.

Dynamic polarization of protons in single crystals of copper (II) Tutton salts was studied at liquid helium temperature as a function of Cu(II) concentration. The data obtained was correlated with the electron spin resonance characteristics. The proton relaxation was shown to take place by a barrier diffusion mechanism. This permitted calculation of the electron spin lattice relaxation rate, which was governed by the direct process at low temperatures and a cluster process at higher temperatures in the liquid helium region. (auth)

28893 (SLL-74-5008) PLATING PROBLEMS ASSOCIATED WITH ALUMINUM CIRCUITRY. Johnson, H. R.; Dini, J. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1974. Contract AT(29-1)-789. 39p. (CONF-741005-1). Dep. NTIS $5.00.

From electronic connector symposium; Cherry Hill, New Jersey, USA (23 Oct 1974).

Corrosion and blistering have occurred during copper cyanide plating of aluminum circuitry. Two cases in which these problems

have occurred are described and analyzed, and procedural changes which solved the problems are discussed. The most effective methods of plating electrodeless nickel on aluminum are also described. (auth)

Physics and Engineering

28894 (AERE-R-7744) TEST TO DESTRUCTION OF LIQUID NITROGEN DEWARS. Yeats, F. W.; Cohen, L. R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). May 1974. 27p. Dep. NTIS (US Sales Only) $4.50. UK 50 Pence.

A detailed account of a series of experiments that tested a number of 75-liter capacity copper-constructed liquid nitrogen dewars to destruction is given. The dewars were destroyed by pressure explosions or by pressure implosion and a comparison was made of the debris derived. The pressures at bursting point were noted and compared. Experiments were carried out to determine the normal boil off rate from a dewar and to find the boil off rate on a dewar with the vacuum insulation destroyed. (auth)

28895 (BNL-18877) MOLECULAR PROPERTIES OF ATMOSPHERIC ION CLUSTERS AND THEIR RELATIONSHIP TO NUCLEATION. Castleman, A. W. Jr.; Tang, I. N. (Brookhaven National Lab., Upton, N. Y. (USA)). Sep 1973. 3p. (CONF-740911-1). Dep. NTIS $4.00.

From fifth international conference on atmospheric electricity; Garmisch-Partenkirchen, F. R. Germany (2 Sep 1974).

Studies of the bond energies and entropy changes resulting from successive molecular additions to the clusters and an investigation of the phenomena of ion-induced nucleation are presented. Results were obtained for clustering of water vapor about the radon progeny ions Pb^+, and Bi^+, Na^+ and H_3O^+; ammonia about Bi^+, and water vapor and SO_2 about NO^+, H_3O^+, and Na^+. (MCW)

28896 (CONF-740904-3) WATER FLOW THROUGH SATURATED-UNSATURATED POROUS MEDIA FINITE-ELEMENT-GALERKIN METHODS. Reeves, M.; Duguid, J. O. (Oak Ridge National Lab., Tenn. (USA)). 1974. 22p. Dep. NTIS $4.25.

From 1st international conference on computational methods in nonlinear mechanics; Austin, Texas, USA (23 Sep 1974).

The equation for saturated-unsaturated moisture flow is presented, spatially discretized using the finite-element-Galerkin technique, and temporally discretized using finite differencing. Experience with four different nonlinear techniques is mentioned. One example using the Picard iteration scheme is presented and different convergence criteria are compared. (auth)

28897 (COO-1105-210) SIMPLE APPROACH TO ANALYZING BASIC OPTICAL INSTRUMENTS. Progress Report, July 15, 1973-July 15, 1974. Durand, B.; Moran, P. R. (Wisconsin Univ., Madison (USA). Dept. of Physics). [nd]. Contract AT(11-1)-1105. 13p. Dep. NTIS $4.00.

An approach to teaching about optical instruments is given. It is pointed out that all geometrical optical instruments can be understood as the cascading of three basic instruments: the camera, the projector, and the adjustable magnifier. (WHK)

28898 (EFI-15-73) DESCRIPTION OF MACROSYSTEMS IN NONEQUILIBRIUM STATE. Gol'dman, I. I. (Erevan Fizicheskij Inst. (USSR)). 1973. 20p. (In Russian). INIS.

The physical basis is given for a method of constructing the total function of distribution of probability for classical macro systems consisting of identical particles in a nonequilibrium state. Mathematical expressions are developed for an incomplete description of the system at different levels of detail of information on it, and a description using a single-particle distribution function and density and current distribution is especially carefully considered. The expressions developed make possible a very convenient examination of the properties of the equilibrium state, in particular the theory of Meyer. A generalization of the latter was made which considers triplex (and higher) interactions between particles. (tr-auth)

28899 (LBL-2587(Rev.)) NEW 1000°C DOUBLE TILT STAGE FOR THE HITACHI 650 kV MICROSCOPE. Worthington, W.; Kosel, T.; Sinclair, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1974. Contract W-7405-eng-48. 2p. (CONF-740803-4). Dep. NTIS $4.00.

From 32nd annual meeting of the Electron Microscopy Society and Exhibition; St. Louis, Missouri, USA (13 Aug 1974).

A new 1000°C specimen holder has been developed for the Hu-650 electron microscope and is interchangeable with other holders for the recently designed orthogonal drive tilting state. The requirements for the high temperature device were as follows: 1. An orthogonal double-tilt stage with all original design criteria maintained. 2. Capability of heating standard (3 mm dia) metallurgical specimens to 1000°C. 3. Geometry and materials should be such that stage and microscope components shall not be damaged by heat from the specimen holder. 4. The electric current to the heating element shall impart a minimum effect upon the microscope electron beam. 5. Heating and cooling rates to be as rapid as possible. (auth)

28900 (LBL-2708) COHERENCE IN EXCITED TRIPLET STATES OF MOLECULAR CRYSTALS. Fayer, M. D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 153p. Dep. NTIS $10.75. Thesis.

Two distinct topics presented are: the effects of coherent Frenkel-exciton migration and exciton detrapping on band-trap equilibria in solids and the coherent coupling of two excited state energy levels by an applied radiation field for a system that undergoes incoherent feeding and decay of population. These are discussed in terms of excited triplet states of molecular crystals, although the considerations presented are quite general. A model is developed that relates the dynamics of energy migration in crystals to the mechanisms by which thermal equilibrium between delocalized band states and localized trap states is achieved. From these experiments, both the sign of the intermolecular interaction matrix element and the dispersion of the first excited triplet band in addition to an estimate of the coherence length associated with exciton migration in the Frenkel limit are obtained. A technique for measuring the decay of localized excited triplet states into delocalized band states of a solid utilizing the optical detection of electron spin coherence is described. Coherent coupling of two excited triplet spin sublevels by an applied microwave field is treated with the effects due to population entering and leaving the ensemble of excited triplet states included. (MCW)

28901 (NASA-SP-5925(03)) BONDING AND JOINING TECHNOLOGY. A Compilation. (National Aeronautics and Space Administration, Washington, D. C. (USA)). 1974. 23p. NTIS $1.00.

The compilation contains 28 technical briefs in three sections on bonding, brazing, and joining technologies. Patent information on the procedures is included. (MCW)

28902 (ORNL-HUD-28) TECHNICAL AND INSTITUTIONAL ASPECTS OF COMMON TRENCHING. Boegly, W. J. Jr.; Griffith, W. L.; Compere, A. L.; Brown, W. H.; Lord, J. H. (Oak Ridge National Lab., Tenn. (USA)). Aug 1974. Contract W-7405-eng-26. 123p. Dep. NTIS $7.60.

Common trenching experiences in the U. S. are reviewed and the resulting advantages are discussed. The co-installation of water and sewer lines is discouraged in all states that answered a survey, but co-installation of gas and electric with either water or sewer lines is permitted in most states. The findings from a housing subdivision development in Knoxville, Tennessee are presented. In Tennessee, also, Memphis Light, Gas, and Water practices joint trenching of electric and gas lines in all new subdivisions. (MCW)

28903 (SC-DC-721816) IMPROVED THERMAL DESIGNS FOR A CYLINDRICAL ELECTRICAL IGNITER. Smith, J. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1973. 42p. (CONF-740925-3). Dep. NTIS $4.25.

From 5th international heat transfer conference; Tokyo, Japan (3 Sep 1974).

The thermal analyses of the miniature electric primer or igniter described involves two trends in technology, miniaturization, and the use of thin films. This device contains an electrical bridge in the form of a circular disk with a radius of about one-tenth centimeter and nominal thickness of 1000 Å. The bridge or thin film is vapor deposited onto a glass substrate and an explosive powder is then pressed against the bridge inside the cylindrical case. The great disparity in axial and radial dimensions of the bridge can lead to numerical difficulties in differencing the diffusion equation that describes heat flow through the bridge. The usual bulk material properties are questionable for very thin materials. (MCW)

28904 (SLA-73-7034) BLAST PRESSURE TRANSDUCER USE AT SANDIA LABORATORIES. Leisher, W. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 11p. (CONF-740931-2). Dep. NTIS $4.00.

From 4th international symposium on military applications of blast simulators; Berkshire, UK (9 Sep 1974).

Blast pressure measurements and some solutions involving flush diaphragm transducers, both piezoelectric and piezoresistive (strain), were made. Blast pressure measurements are affected by transducer frequency response, resonance, acceleration (shock) sensitivity, and thermal zero shift caused by shock heating. Acceleration sensitivity and ruggedness are more important than usual when transducers are mounted on freely

responding test pieces receiving several thousand g's (1g = 9.8 m/s^2). Piezoelectric transducers have high resonant frequencies and good frequency response but are subject to zero shifts due to heating and acceleration. Some artificial crystal materials will zero shift when excited at their natural frequency, a not unusual occurrence when measuring blast waves. Coaxial cables used with these transducers can cause spurious signals if moved during the data period; however, these signals can be eliminated by using line driver amplifiers. Piezoresistive transducers are usually somewhat less shock sensitive than piezoelectric transducers but are more deficient in other areas, especially in frequency response. Cable noise is no problem since low output impedance, typically, .5 to 1 k ohms, permits use of ordinary stranded wire. (MCW)

28905 (SLA-74-5321) USE OF FLUOROCARBON GASES TO PREVENT ARCOVER IN DC CAPACITORS. Loescher, D. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 12p. (CONF-741008-2). Dep. NTIS $4.00.

From conference on electrical insulation and dielectric phenomena; Downington, Pennsylvania, USA (21 Oct 1974).

The use of Fr-14 (CF_4) and Fr-116 (C_2F_6) to increase the margin arcover voltage in dry Mylar energy storage capacitors is investigated. It is found that pressurization of capacitors with Fr-14 results in a small increase in arcover voltage. However, pressurization with Fr-116 results in arcover voltages 1.5 to 2.5 times larger than obtained in air. (auth)

28906 (SLL-73-5294) FLOW FIELD TEMPERATURE DISTRIBUTION DETERMINATION USING ROTATIONAL RAMAN SPECTROSCOPY. Smith, J. R.; Giedt, W. H. (Sandia Labs., Livermore, Calif. (USA)). Oct 1973. Contract AT(29-1)-789. 7p. (CONF-740925-2). Dep. NTIS $4.00.

From 5th international heat transfer conference; Tokyo, Japan (3 Sep 1974).

The development of a high-powered laser and low-light-level television system for obtaining the frequency and spatial distribution of pure rotational Raman scattering from steady state and transient gas flows is described. The system has a temporal resolution of about 30 milliseconds and spatial resolution better than 0.1 millimeter. The temperature profile over a distance of from 1 to 2 cm is determined simultaneously. Examples of temperature distribution measurements in a cylindrical chamber during the time it is being filled with hydrogen are given. (auth)

28907 (UCID-15620) BIPOLAR JUNCTION TRANSISTORS. Trout, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Nov 1969. 37p. Dep. NTIS $5.00.

The fabrication and tests performed on several bipolar junction transistors (BJT's) designed for high frequency operation are described. A mask design is described which is particularly easy to align. Complete details are included in the Processing Section on thermal oxidation, photoresist (both Kodak Thin Film Resist (KTFR) and Shipley AZ 1350 positive working resist), boron diffusion (with a BI_3 source). Also described is a technique for making metal contact pads with no metal phosphorous diffusion (with a $PICl_3$ source). The Testing Section shows both the static characteristics and the s-parameters of the experimental devices and of an ideal transistor with inter-electrode capacitance. Finally, suggestions are made as to how fabrication of future transistors can be improved. (auth)

28908 (UCID-15627) PULSED ANTENNA ARRAYS. LaTorre, V. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Mar 1970. 18p. Dep. NTIS $4.00.

The single-pulse antenna excitation problem is divided into several parts and discussed. The first is concerned with determining the pattern of an array excited by single pulses of various shapes. At the outset, the receiving and transmitting patterns are considered identical since only passive, linear antennas are assumed. As the work progresses, this restriction may be relaxed. The second portion of the study entails determining an optimum array for achieving a given pattern, or at least the pattern which is closest to the desired one under certain other restrictions, such as cost and physical size. The study is aimed at developing a computer program that provides the optimum patterns for various arrays. The last part of the problem is concerned with methods and practical antenna systems for generating a pulse having a desired frequency spectrum. This will prove extremely valuable in experimentally verifying theoretical performance of the antennas synthesized in the preceding portion of the study. Before actual examination of antennas and antenna patterns, brief attention is given to the frequency spectra of various pulses. The limiting case of a single-cycle pulse is presented to indicate the wideband requirements of the antenna. Practical antennas are then included and their patterns summarized to provide additional insight into the problem. The remainder of the report deals with previous work on pulsed antennas and the transient response of antenna arrays, and concludes with an outline of the approach to the solution of the overall problem. (auth)

28909 (UCRL-75904) FAULT TREE ANALYSIS: AN OVERVIEW. Lambert, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Aug 1974. 17p. (CONF-740906-1). Dep. NTIS $4.00.

From conference on reliability and fault tree analysis; Berkeley, California, USA (3 Sep 1974).

The construction, evaluation, and uses of the fault tree analysis of systems are discussed. (TFD)

28910 (UCRL-75915) PHOTOMASK TERMINOLOGY. Schultz, P. A.; Ciarlo, D. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Aug 1974. 9p. (CONF-740823-2). Dep. NTIS $4.00.

From 18th annual meeting of the Society of Photo-Optical Instrumentation Engineers; San Diego, California, USA (19 Aug 1974).

Standardization of terminology in the IC photomask industry needs to be accomplished in the near future. Difficulties usually encountered when attempting standardization, as well as suggestions on how to approach standardization are discussed. Over 125 representative IC photomask terms have been selected, categorized, and defined. (auth)

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